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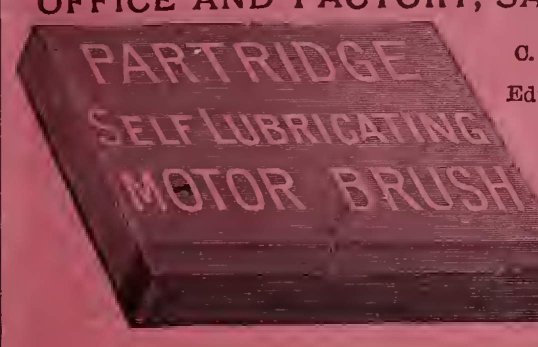

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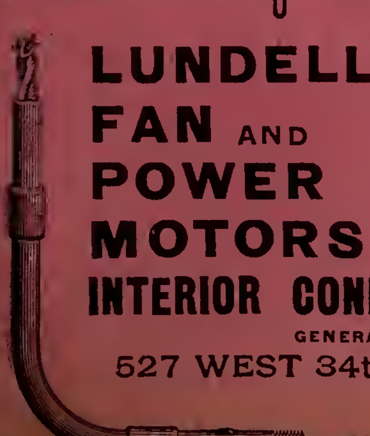

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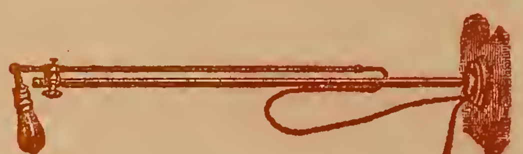

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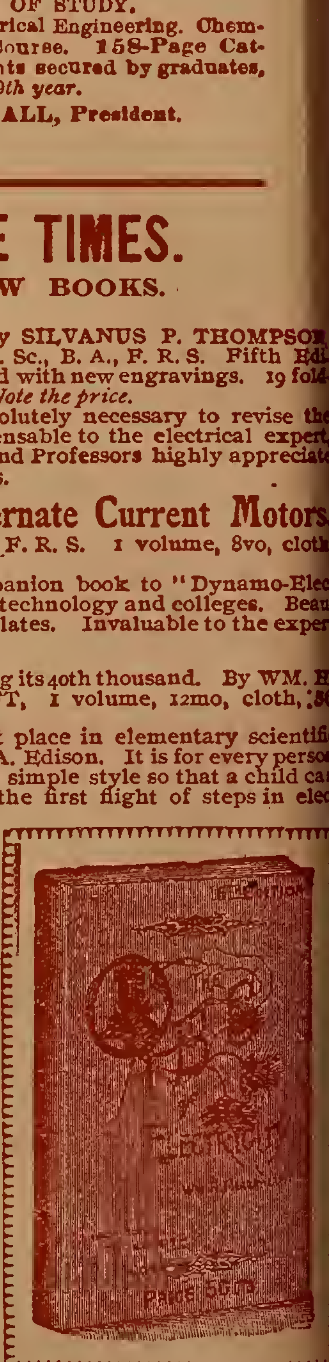

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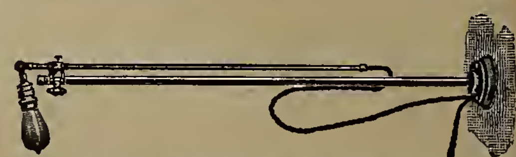

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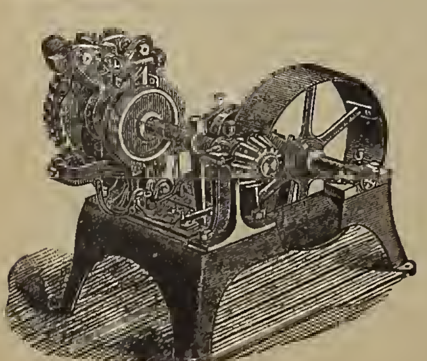

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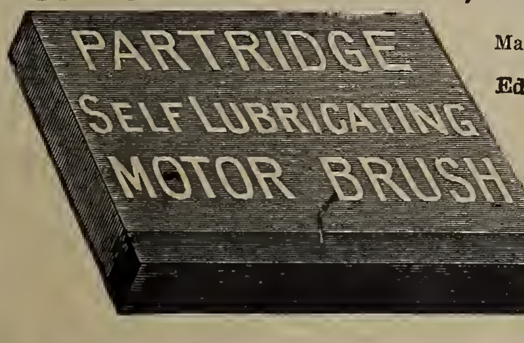

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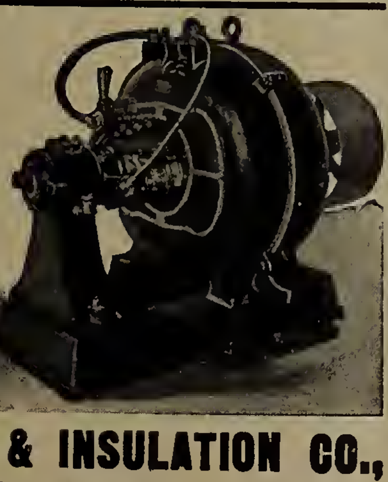

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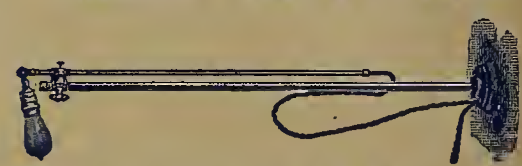

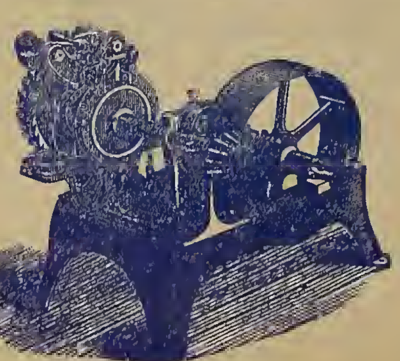

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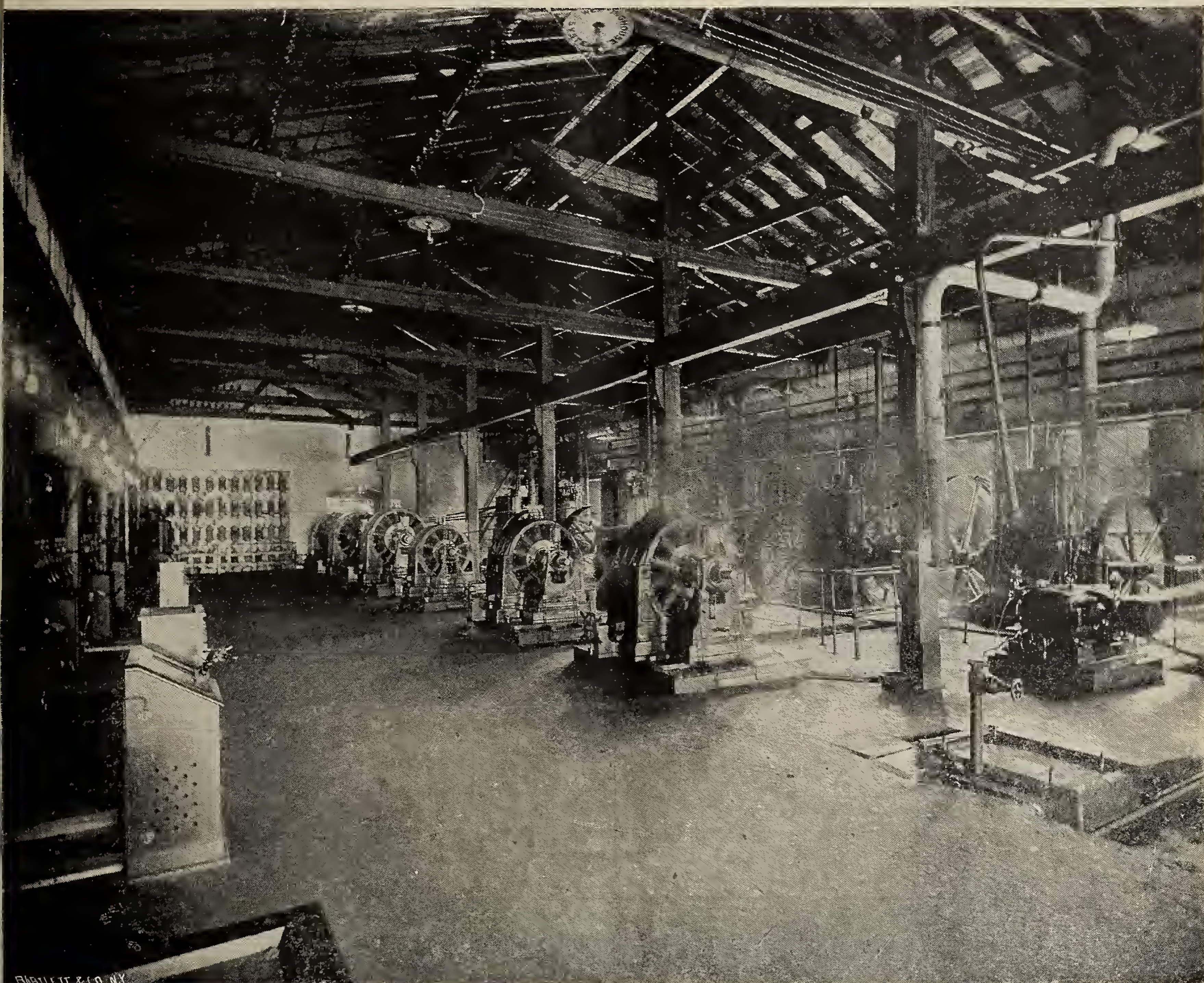


ALTERNATING CURRENT STATION AND SWITCHBOARD.

ELECTRIC LIGHT WIRING AND TESTING.

LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The wiring of buildings is the ultimate final of a street subway system. The current is generated in a central station, distributed either as an alternating or continuous current through the streets in conduits specially prepared and then connected to the wiring circuits of any large house, hall or public building.

This entire city is completely enclosed by a network of underground wires, each insulated from the other and proportioned in size so that the proper pressure and current is delivered at the door of every consumer's house.

The control and care of a subway system is in itself a duty of a most important character.

There is a likelihood of several kinds of trouble developing. Each must be discovered and treated in a manner sufficient to remove either itself or the cause as speedily as possible. There is every means observed on the part of central station managers to take the most jealous care of their subways. It is in the perfection of these and their freedom from faults that the profits of the plant mainly lie.

The wiring of a building can therefore be regarded as the final outcome of an elaborate equipment composed of

(1) A central station plant,
(2) A subway or distributing system.

The main points to be considered in the construction and maintenance of an electric light system, with special reference to the lines either inside or out, are

Freedom from grounds,
Freedom from short circuits.

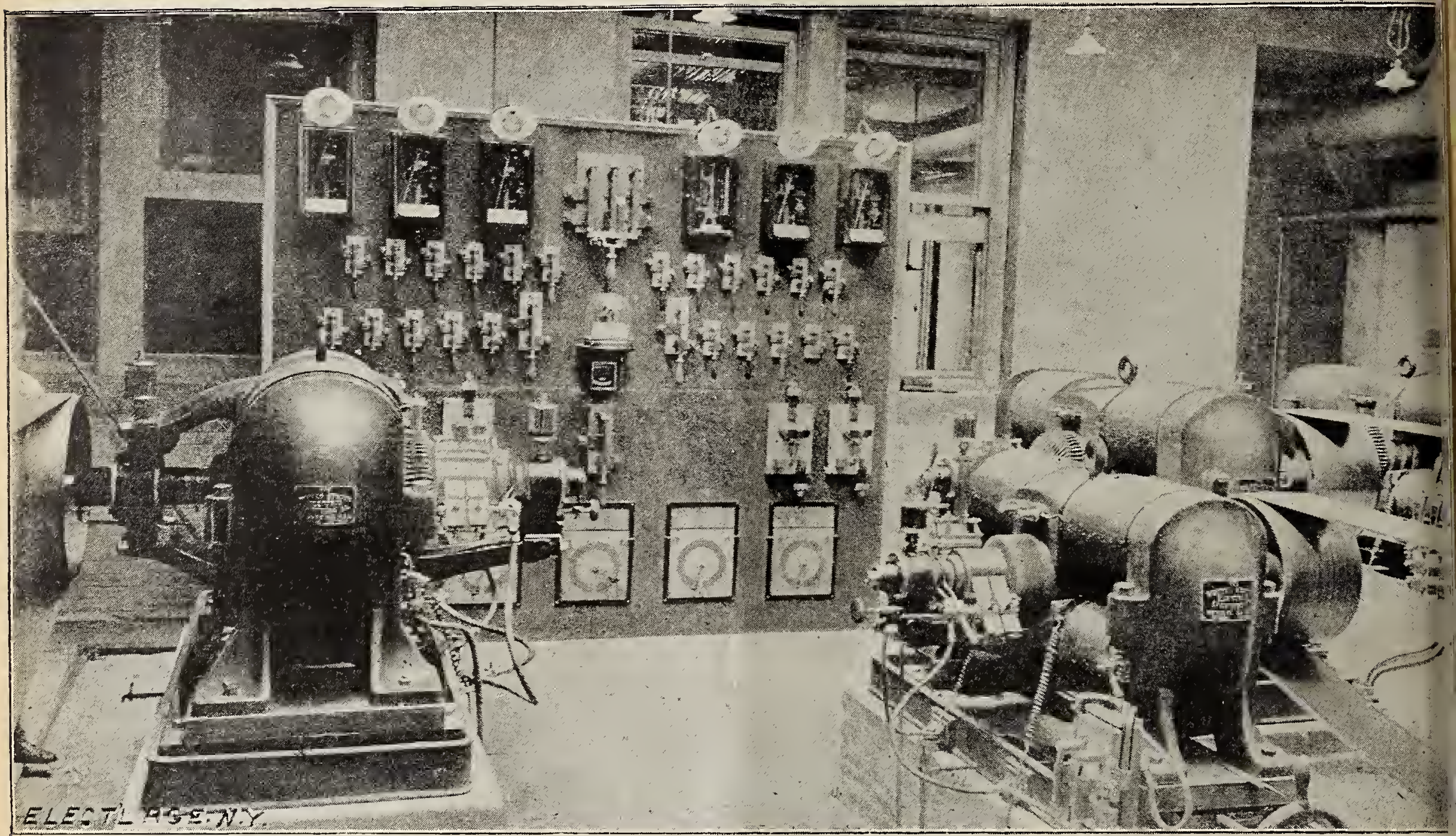
A series of less important troubles are constantly developing, which are still the cause of much more if not immediately attended to—

Poor connections,
Bad joints.

How a Building is Wired.—When a structure of any description is placed in a contractor's hands to wire, it is necessary for him to decide upon several things.

These may be brought to the reader's notice as follows:

(1) The kind of wiring (either 2 or 3 wire).



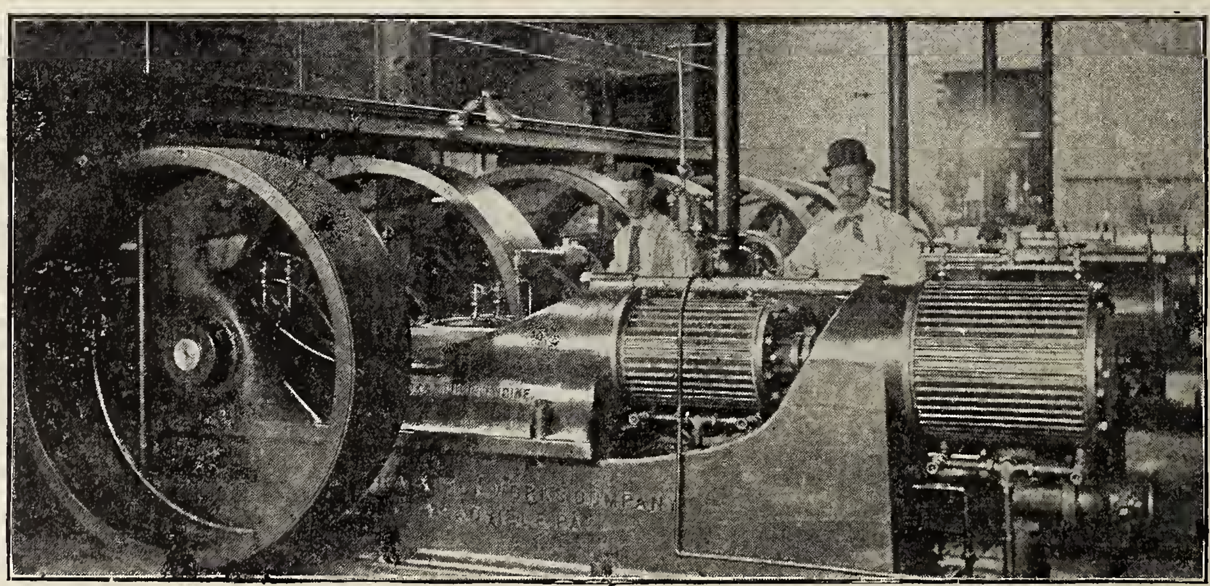
CONTINUOUS CURRENT PLANT AND SWITCHBOARD.

Poor Connections.—The origin of this fault is either hurry or carelessness.

Fire may frequently be started by either of the above causes; their elimination, therefore, is an enforced necessity.

(2) The percentage of drop.
(3) The centre of distribution.

The nature of the wiring will depend to a great extent upon the kind of current entering the building—whether it is continuous or alternating. Usually buildings that use



HIGH SPEED ENGINES FOR STATION SERVICE.

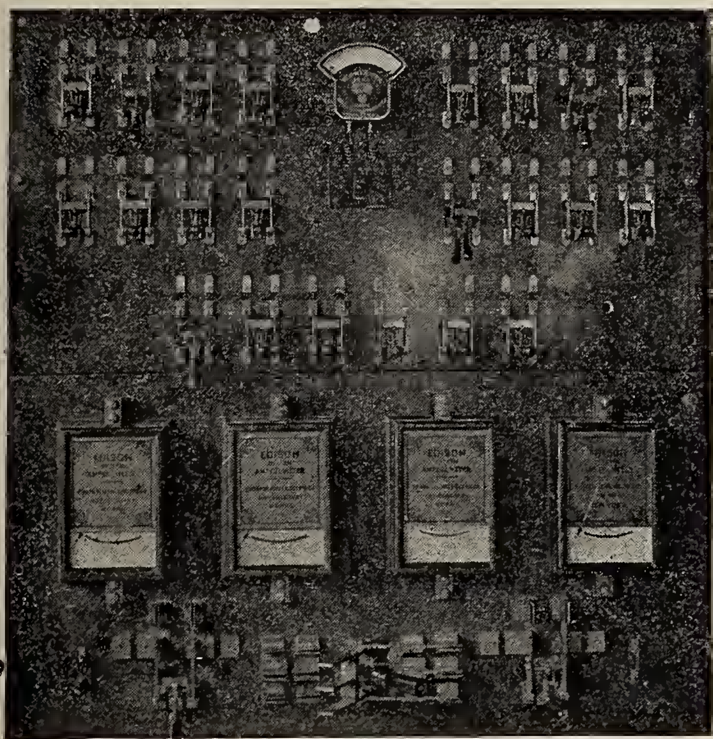
A wire loosely placed under a screw will generate heat and possibly set fire to something in the neighborhood. In addition the looseness of contact will mean resistance in circuit with the line and cause a decided drop. The evil results in this case are practically similar to those developed in the second case, due to bad joints. They are risks from fire or loss of pressure.

alternating current are wired with the ordinary two-wire system. *The two factors affecting the size of wire or amount of copper used are the percentage of drop and the centre of distribution.*

To wire a building successfully the pressure must be retained throughout as high as possible. A network of wires must therefore be used that will effect this result as nearly

as possible. This is where it becomes necessary in attaining this object to select a proper centre of distribution.

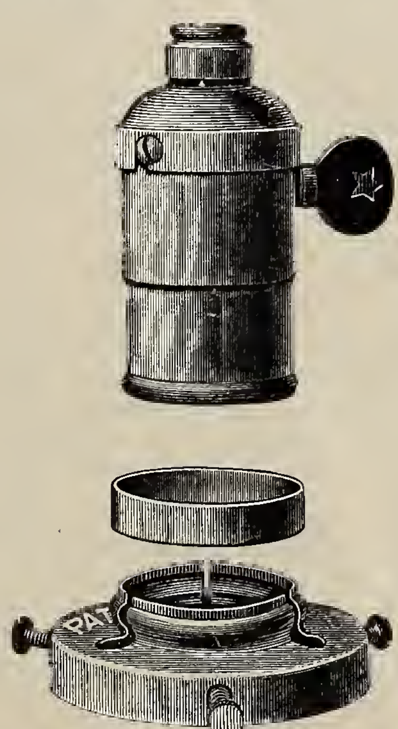
A centre of distribution in a wiring system is a point from which all wires supplying the electric light direct are connected. The wires used in any building, according to their function, may be classified under the heading of



SWITCHBOARD.

Mains,
Feeders,
Branches.

A building of a given size would have a pair of *main* wires run up half way, and then from this point feeders would run above and below, acting as subsidiary mains, and supplying the branches connecting to the lights on the upper and lower floors. This centre, from which all lines stream, is called in compliance with its intended object—*the centre of distribution.*



LAMP SOCKET AND SHADE HOLDER.

The wiring of a house as regards its mains, feeders or branches may all be proportioned by a simple rule whose excellence has been tested in numerous cases. The pliancy of this rule is due to the fact that it takes into consideration the distance in feet, amperes and circular mils,

$$\frac{2 \times \text{distance in feet} \times \text{amperes} \times 12}{\text{volts drop.}} = \text{C. M.}$$

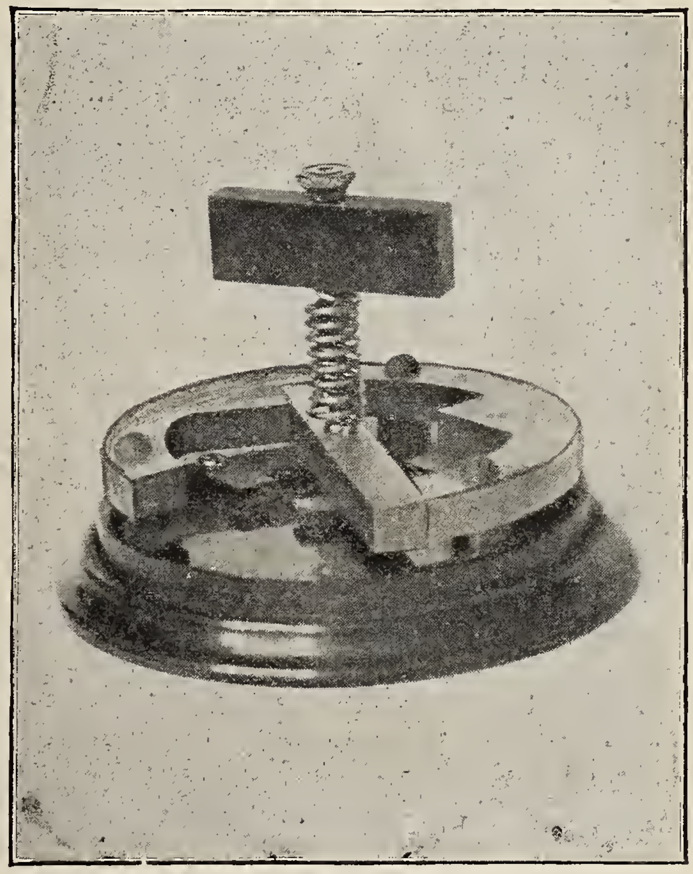
where C. M. = circular mils.

The application of this rule may be illustrated by the following example :

Length of line = 1,000 feet,
Amperes = 50 "
Volts drop = 10 "

$$\text{Size of wire in C. M.} = \frac{2 \times 1{,}000 \times 50 \times 12}{10}$$
$$= 120{,}000$$
$$= \text{No. 00 B. \& S. gauge.}$$

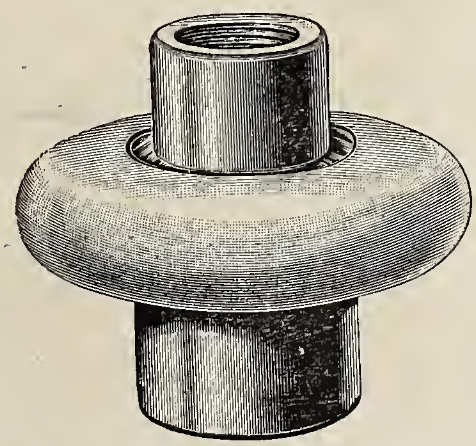
The size of any copper conductor may be found provided



SWITCH FOR LIGHTS.

the volts lost, the number of lamps and the length of the run in feet is known; an excellent rule for arriving at the size of wire is to *remember* that a No. 10 wire B. & S. has about 10,400 C. M. cross section, and each wire three sizes above or below doubles or halves in cross section. For instance, a

No. 13	B. & S.	approx.	5,200 C. M.
10	"	"	10,400 "
7	"	"	20,800, etc.



INSULATION BETWEEN CHANDELIER AND GAS PIPE.

This will enable a rapid mental calculation to be made of the size of wire from the circular mils obtained.

Twice No. 10 is No. 7, and four times No. 10 is No. 4, etc. In the last case the C. M. arrived at were 120,000. A size of wire about 12 times as large as a No. 10 would have 120,000 C. M. We therefore consider

2 ×	No. 10	=	No. 7
4 ×	10	=	4
8 ×	10	=	1
12 ×	10	=	00

The main fact to consider is, that when a wire doubles in circular mils it decreases three *numbers* in size.

A No. 10 wire is 10,400 C. M.; a wire twice its circular mils would be 20,400 C. M., but pass in number from No. 10 three sizes, or become No. 7.

The intervening gaps may be filled in in thirds in the following table:

Approx.	166,400	No. 000	=	167,805	C. M.
"	83,200	1	=	83,694	"
"	41,600	4	=	41,743	"
"	20,800	7	=	20,817	"
"	10,400	10	=	10,382	"
"	5,200	13	=	5,178	"

The column obtained on the basis considered and the real value of the circular mils shows that the nearest size to this approximation will be satisfactory.

The development of a wiring system may be easily considered after the sizes of wire have been obtained.

Drop in Mains.—The drop in mains usually allowed is about five per cent., and in feeders and branches two per cent. The loss in the subways leading from the station to the door may be as much as ten per cent., and provided the pressure is kept constant no evil results follow. Variations in pressure in the subway, however well the place may be wired, will cause ruin and damage to the lamps. Either their pressure will fall very low or become too high and decrease their life.

Testing.—A ground or a short circuit are two common faults in newly-wired buildings. The insulation test will bring to light the true condition of the building. Wires imbedded in moist plaster will show a very low insulation resistance. The usual value of this is reckoned by the underwriters as exceeding three megohms (3,000,000 ohms). A Wheatstone bridge is employed for the purpose of localizing trouble. A short-circuit will not only blow fuses continually, but show an exceedingly low resistance with the bridge. It may be in a chandelier caused by crossed wires, or it might be due to defective cut-outs, etc. The blown fuse usually indicates the position of the fault. Grounds are shown by the great and in some cases abnormal decrease in the insulation of the wire. A wire of the bridge connected to earth and another to a main quickly determines the value of the insulation. When the building is free from grounds, short circuits and poor connections, and shows a proper and reasonable perfection, current may be applied to its lamp circuits without further delay.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Magnet Coil.

Newark, N. J., June 22, 1896.

Dear Editor:—Please inform me how to construct a magnet or solenoid to lift from 60 to 75 pounds; must not be over 2¼ or 2½ inches outside diameter. If this is too small, make it for two smaller ones.

It will be used on a 110-volt circuit and must not heat to a very great extent. I want them to lift and let go a certain number of times a minute for about 10 hours. I will be greatly obliged if you will let me know at once.

Yours respectfully,
J. Ruf.

P. S.—I also state that I am greatly interested in your first-class paper and think very much of it.

(*A.*)—The solenoid you speak of would have to be in a horseshoe form to lift 60 pounds. No single coil alone, unless it was very large, could do it. The size of coil mentioned could hardly lift that much weight easily. Make the magnet core 1¼ inches in diameter and about four inches long.

The pull ought to be about 75 pounds with wrought iron well annealed. Wind on about five pounds of No. 24, B. & S. At a specific induction of 10,000 lines of force per square cm., good wrought iron will sustain 58 pounds per square inch of cross section.

(*Q.*)—Motor for a Launch.

Old Point Comfort, June 26, '96.

Dear Sirs:—I am in constant perusal of your inquiry column. Should be pleased to have you answer the following questions:

(1) At what speed should a 1-horse-power motor be run at in a launch?

(2) How must I use discretion in selecting a screw propeller?

(*A.*)—To (1), we say that the speed of a motor is determined by the speed of the boat and the diameter and pitch of the screw.

To (2), the propeller's size is obtained as follows:

Multiply its pitch by its revolutions per minute to obtain the speed of the boat in feet per minute. At eight miles an hour this would be 704 feet a minute. If the pitch of the screw is two feet, it would have to make 307 revolutions a minute, not considering slip.

(*Q.*)—Windmill for Dynamo.

Auburn, N. Y., June 23, '96.

Electrical Age Publishing Co.

Dear Editor:—Is it possible for me to use a large windmill to run a dynamo. I live in the country and could easily connect a dynamo instead of a pump to the windmill. Kindly answer.

Yours truly,
Thomas M. Tice.

(*A.*)—A windmill can be used if the speed is controlled. The dynamo must be supplied with a regulator so that when the speed increases too much the dynamo will not be injured. A windmill with arms that can be turned full to the wind or made to tack would be best. Usually storage batteries are used in connection with an outfit of this kind—the electricity from the cells always being used and flowing evenly, while that from the dynamo may be generated in fits and starts. The mechanism for the dynamo would be called an automatic cut-off.

(*Q.*)—Grounding a Wire.

Hurleyville, June 17, '96.

Dear Editor:—In connecting a telephone line between my home and a friend's I use one wire; the other is grounded. The telephone is all right, but the grounded wire seems to be wrong. Can you advise me?

Yours respectfully,
Edgar Quincey.

(*A.*)—The line is not properly grounded. Sink a large plate of iron in a deep hole near a stream or well, or at least select moist earth and pack around the plate coke, coal, old metal, etc. Do this at each end of the grounded line and the telephone will work.

Measuring X Rays.—An aluminum quadrant has been devised to measure the actinic power of the Roentgen rays. The aluminum is arranged in concentric layers varying from one to ten millimeters in thickness. Measurements are made by holding the quadrant between the excited Crookes' tube and a phosphorescent screen or a sensitized plate.—*Industrial World.*

Pocahontas, Va.—The Flat Top Central Electric Power Supply and Traction Co. will operate a line of electric cars from Pocahontas to Norwood.

RESULTS ACCOMPLISHED IN DISTRIBUTION OF LIGHT AND POWER BY ALTERNATING CURRENTS.

(*Continued from page* 346.)

W. L. R. EMMET.

A NUMBER of large plants have been installed within the last two years, using the three-phase system, as here shown.

Figure 2 shows the connections for distribution by the monocyclic system. Here all lights are connected single-phase between a single pair of conductors leading from the generator, the motors being operated from the same single-phase circuit in combination with a third conductor leading from what is known as the "teazer coil" on the generator. Here the simple three-wire system is used for secondary distribution, and if it is desired to connect motors to the low tension mains, a supplementary transformer is used, which supplies a secondary teazer wire; to this and the outside wires of the three-wire system the motors are connected.

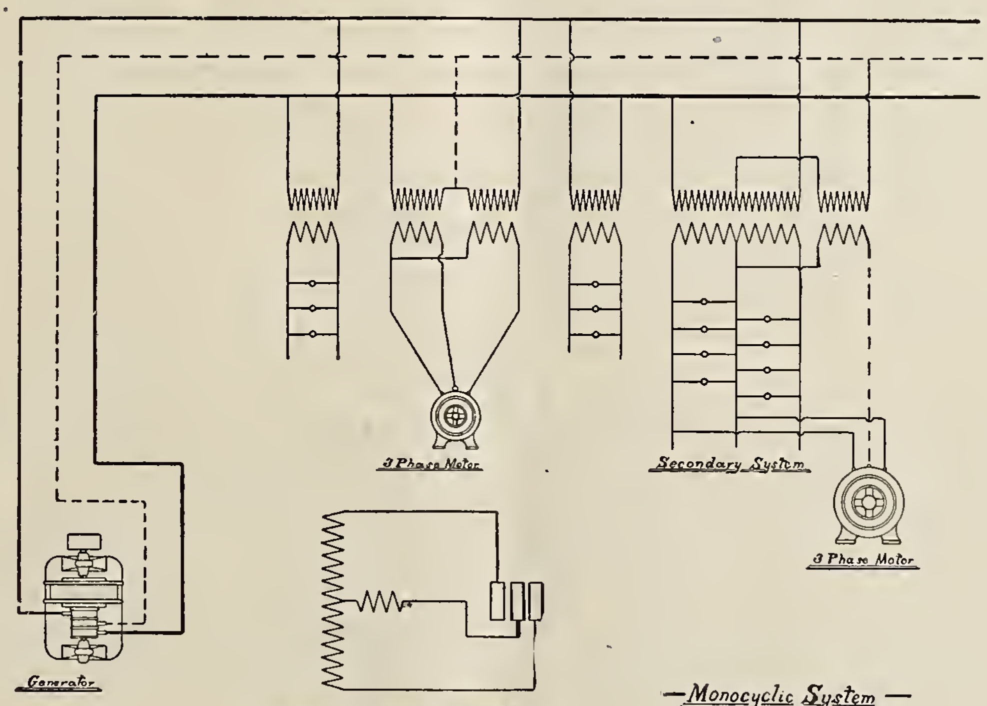
The great merits of the monocyclic system are that the number of conductors required for lighting and power distribution is reduced to a minimum, and that no unbalancing is possible. The operation of three-phase motors from this system is in all practical respects the same as when they are run from three-phase circuits.

Figure 3 shows the connections of the two-phase system with distribution by four conductors. Here the lighting is divided between two separate circuits, which must be kept balanced within certain limits, depending upon the regulation of the generator, or the amouut of care that can be given to the adjustment of pressure on the different sides. Where motors are run, the two circuits must be brought together.

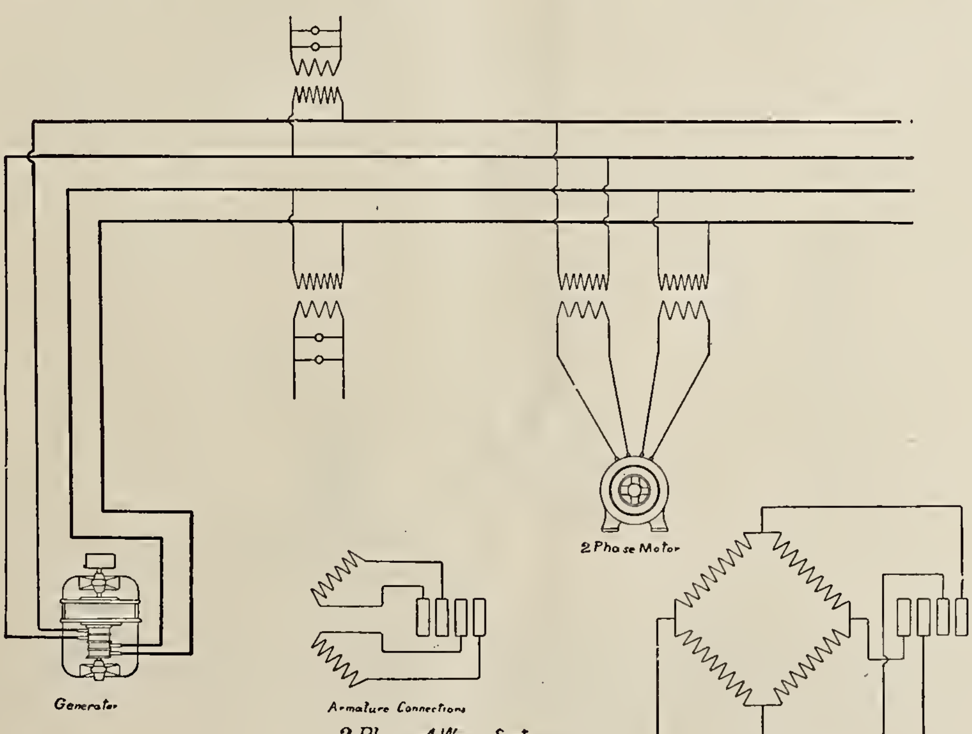
There is no economical and convenient way of operating secondary distribution from this system. Two independent three-wire systems could be operated, but these must be brought together when motors are to run. The complication of balancing such a system would be prohibitory.

The two-phase, four-wire system can be operated either from a generator with two independent circuits, or all four conductors can lead from one armature winding. Certain advantages may be claimed for both methods, and both have disadvantages.

Figure 4 shows a method of single-phase lighting distribution from a two-phase dynamo. Here the two single-phase leads are taken out at points 180 degrees apart on a progressive armature winding. At points ninety degrees



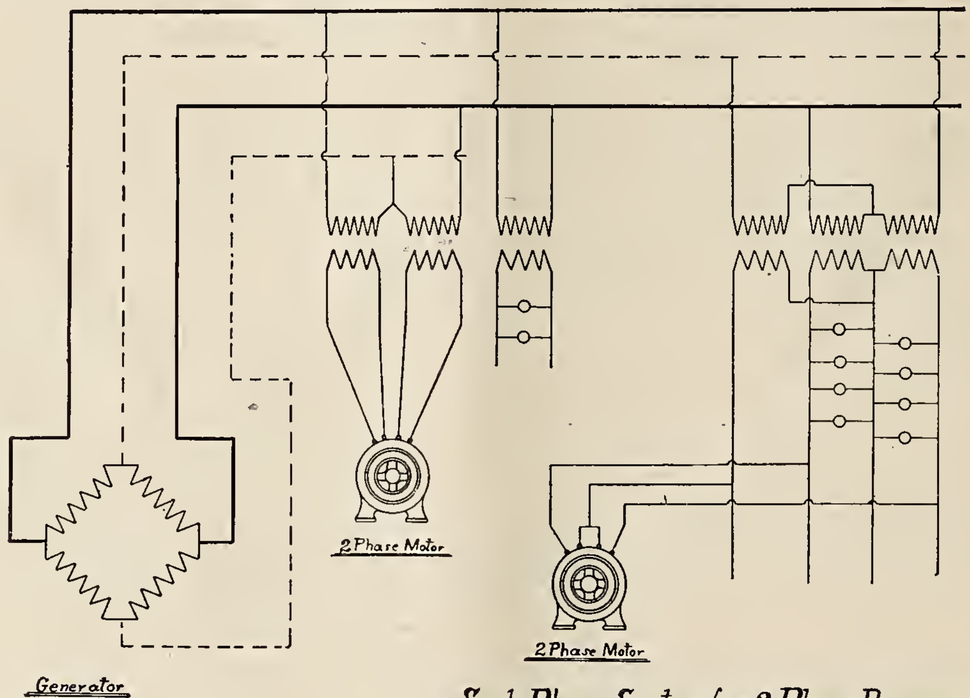
—Monocyclic System —
Fig II



2 Phase 4 Wire System
Fig III

from those leads two other leads are brought out; each of the latter can be used with the pair of single-phase leads to run one-half the capacity of the machine in two-phase motors. These two power loads can, however, be brought together.

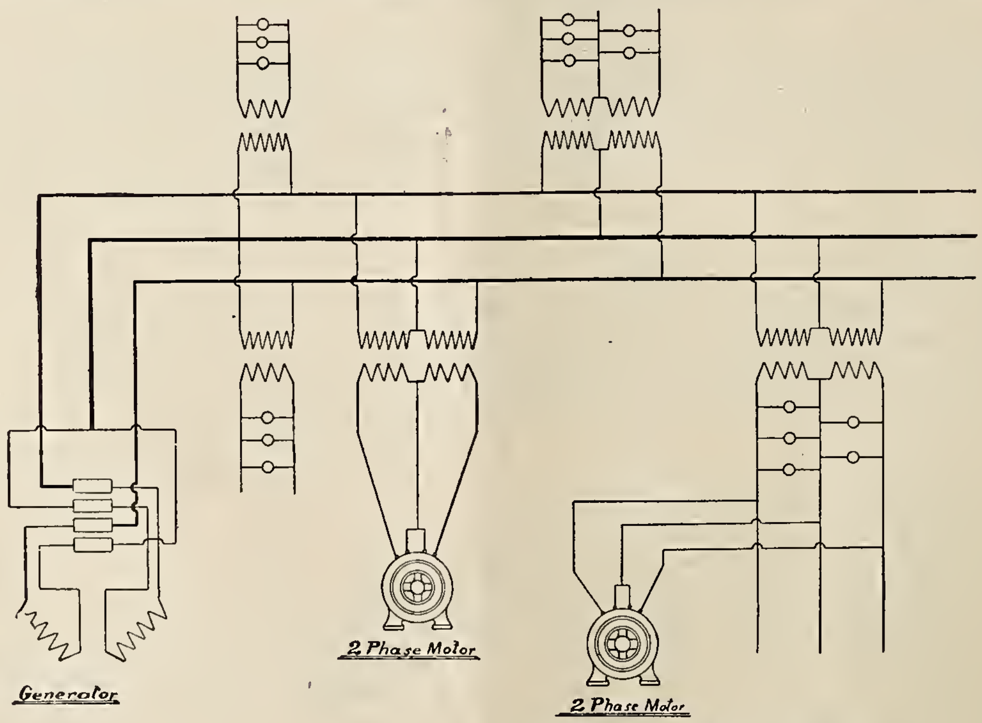
The greatest disadvantage of this system is that, when carrying a single-phase load, a large proportion of the armature conductors are ineffective, and simply introduce useless resistance and self-induction in the circuit. Thus with the same loss the generator will deliver forty-two per cent. more power as a quarter-phase machine than it will as a single-phase machine.



Single Phase System form 2 Phase Dynamo.

Fig IV.

Figure 5 illustrates the two-phase, three-wire system, which has been used to some extent both for high-tension distribution and for distribution by secondary mains. The principal advantage in this system is that it requires one less conductor than the four-wire, two-phase system. Its disadvantages are that the insulation of the apparatus is subjected to a voltage forty-two per cent. higher than that which is available in transmission, and that the self induction in the lines and transformers causes an unbalancing of the voltages on the two sides of the system, accompanied by the distortion of the phase variation. The extent of this unbalancing depends upon existing conditions, and is very different in different cases.



2 Phase 3 Wire System

Fig V.

(*To be Continued.*)

Nebula.—The term nebula has been used to designate any of those cloud-like patches of faintly luminous matter, of which thousands are seen by the telescope to be scattered over the dark background of the heavens. It has been shown by the telescope that some of these objects are extended masses of incandescent gases or vapors; these are the true nebulæ.—*Peck's Astronomy.*

Darkness.—The phenomena of darkness is the opposite of that of light. Yet there is no more in space where darkness predominates than there is directly under the blazing heat of fiery incandescence. Light is a vibration; darkness is its absence.

In reality there is no perfect light, neither is there perfect darkness.

A vibration or oscillation of the luminous ether produces the sensation of light, as the vibrating particles of a body produce the sensation of heat.

When ether is at rest darkness occurs. Since heat rays extend in all directions, even in remote space, there is no absolute darkness, and because the tremulous condition of the ether around the sun is not infinitely quick, the light proceeding therefrom is not the brightest conceivable. This relation of light to darkness is beyond our physical conception. The eye could not withstand the blinding light of the sun any more than it could pierce the stygian depths of uttermost space.

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CONTENTS.

	PAGE
EDITORIALS	
The Day of Independence	363
Alternating versus Continuous Current	363
GENERAL SUBJECTS	
Electric Light Wiring and Testing	357
Results Accomplished in Distribution of Light and Power by Alternating Currents	361
Effect of Temperature on Insulating Materials	364
Railway Notes	365
Evolution of Interior Conduits from the Electrical Standpoint	366
Franklin Leonard Pope	367
INQUIRY COLUMN	360
TRADE NOTES	
Special Drill for Modern Electrical Shops	369
Peckham Motor Truck and Wheel Co	370
Possible Contracts	371
NEW CORPORATIONS	371
New Telephone Companies	371
PATENTS	371
Telephone Patents	372

THE DAY OF INDEPENDENCE.

Washington, the father of his country—the man whose mighty arm wrested liberty from the British lion—whose incomparable grace, sweetness of character, and soldier-like heroism gave us this chance to welcome July the Fourth—was not alone. The declaration of independence was *also* signed by the American father of electricity. Benjamin Franklin magnetized France, but he electrified America. Strange that two countries of even like sympathies should work side by side to develop the same science.

When the declaration of independence was signed the freedom of the American colonies began.

Franklin was an ardent patriot. He stirred the small circles of this country after the war with his experiments in electricity. Lightning rods are used today that have not been improved upon since Franklin's time. Electricians may well be proud of the enterprising spirit that could with equal facility turn from science to the sword; and to have inscribed upon the everlasting records of this country the name of its first electrician, side by side with Washington's.

There is identified with Franklin's patrotism and philanthropy his love of science, his strenuous efforts to pierce the veil of mystery—to steal at deadly risk—the lightning from the skies.

Why should not the Fourth of July be a day of rejoicing to us. The touch of time has not narrowed our sympathies.

This great country is a land of mighty possibilities. The days of blood have passed. The green fields stretch out in the peaceful sunshine. " Homes and hearts " are the watchwords that govern the multitudes. In prosperity and sorrow, in anger and regret their hands are always clasped, their eyes fixed upon a shining light above in which indeed their hopes and hearts are alike placed.

ALTERNATING versus CONTINUOUS CURRENT.

Shakespeare has said "'Tis better to endure the ills we have than fly to others that we know not of." In considering any departure from the routine of practice nothing is more true. Nothing, however, proves so much a brake to progress—a retarding influence that may with the best of intentions destroy a fruitful move and hamper the enterprise and spirit of a conscientious worker. In all fields of labor, crude or skilled, the element of most vital value is that which encourages what might be called a legitimate variation. A change from the old to satisfy a yearning curiosity may be productive of good—not immediate—but visible in after days, and of such weighty influence as to redirect the course of investigation perhaps to a successful issue. Cancelling the chances of doubt as factors entering into every practical test as well as theoretical calculation, what will be the final and most prevalent system—the continuous or the alternating? Will power plants suppress the growth of alternating-current practice by refusing to use their system, or will the future see a change, a favorable and permanent change in the adoption of an alternating system as the best for transmitting power and to cap the climax, if not the best, at least the cheapest.

Power transmission is today most popular with alternating currents. Will this prove eventually to be its final field? We think so. The spread of alternating-current practice, the growth of the multiphase motor trade, the adoption by the very largest transmission plant in the country of alternating current apparatus, we think, tells the tale. Continuous current for the city, but alternating for the transmission of power.

South African Diamonds.—In 1867 the first diamond ever found in South Africa was picked up by a hunter out of a heap of shining river pebbles. This was near the banks of the Orange River, a little above its confluence with the Vaal River. Then a diligent search for dimonds began in all the surrounding districts. In 1870 diamonds were discovered in considerable quantities near where the town of Kimberley now stands. A rush of miners soon filled the neighborhood, and from that time onward Kimberley has been the centre of the diamond-getting industry, though there are other mines scattered here and there to the west and south of it.—" Impressions of South Africa," by James Bryce, M. P., in the July *Century*.

A Delicate Instrument designed by Mr. Horace Darwin will indicate slow tilts and pulsations of the earth's crust of less than 1-300th of a second, or an angle less than that subtended by a line an inch long at a distance of 1,000 miles. It consists of a circular mirror suspended from brackets on an upright by two wires of very unequal length. Slight tilting of the upright causes exaggerated motion of the mirror, and the spot of reflected light moved half an inch when a finger was laid gently on the marble window set supporting the apparatus.—*Invention.*

Fresh Water from Granite.—In the Island of Arko, off the Swedish coast, a well was sunk in 1894 at the depth of 110ft., into granite rock, and fresh water was found sufficient to supply 4,400 gallons a day to the inhabitants of the island. Since that day other wells have been bored for, and discovered in granite. The discovery was due to a Swedish scientist, Nordenskjold by name, who has long maintained that water can be found by boring into crystalline rocks to a depth of from 100 to 170ft. This is particularly useful where pilot stations and lighthouses have to be provided with fresh water and that in plentiful quantities.—*Invention.*

EFFECT OF TEMPERATURE ON INSULATING MATERIALS.

A paper presented at the General Meeting of the American Institute of Electrical Engineers, New York, May 20th, 1896.

BY GEO. F. SEVER, A. MONELL AND C. L. PERRY.

(*Continued from Page* 348.)

Examining the several curves shown, we see that the initial resistance of unprotected papers is low on account of the presence of moisture. Now, on gradually increasing the temperature, the resistance falls during the first 20 degrees or 30 degrees, because the effect of the temperature coefficient predominates during this period and before the material is warm enough to start the evaporation of the moisture it contains. This, however, lasts but a short time, as the result of the evaporation is to increase the resistance very rapidly, until at 75 degrees the temperature coefficient again asserts itself and the resistance rapidly falls.

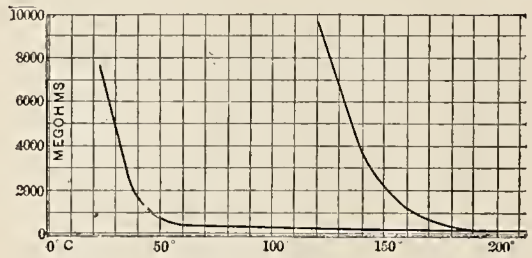


FIG. 3.

In the case of japanned papers (Fig. 3) the initial resistance is very high, due to the absence of moisture, but on being heated the resistance drops rapidly as the small quantity of water contained is evaporated off so slowly that it has very little counteracting effect on the temperature coefficient.

Paper does not seem to deteriorate mechanically at less than 180 degrees; above this point the material begins to carbonize. At 230 degrees a peculiar phenomenon takes place. The material after possessing a very low resistance from 175 degrees upward, would at about 230 degrees suddenly increase greatly in resistance and immediately after break down. This may be caused by some molecular rearrangement taking place at that temperature which changes the resistance of the material. Other cases wherein the resistance of a body changes at a certain temperature are well known. In the phenomenon of "recalescence" a piece of iron or steel after having been heated to a bright redness and allowed to cool slowly will, at a certain stage of the cooling process, receive a sudden check—heat being generated in the metal as a result of the change which the molecular construction suffers at the critical point. The cooling is arrested and the temperature and resistance rise though the loss by radiation is still going on.

The experiments of F. Kohlrausch and Hopkinson have also shown that the critical temperature is marked by a sudden change in the coefficient, which expresses the effect of temperature on the electrical resistance of iron. This is also true of nickel.

It would seem that paper insulation has a critical temperature somewhat analogous to that of iron, steel and nickel, but, of course, the characteristics of the materials are too different for any close similarity.

PLAIN CLOTH.

Under this head 20 specimens were tested, including canvas, linen and muslin, of different thicknesses. The action of this material (Fig. 4) is much the same as that of paper (Fig. 2). The initial resistance is lower, as it contains more moisture than is the case with paper; for the same reason when the moisture evaporates off, the increase over the initial resistance is greater than with paper. By reference to the curves of paper and cloth it will be noticed that their resistance varies in the same manner. For cloth, as for paper, the maximum resistance is at 75 degrees C. The material does not begin to carbonize until at a temperature of 180 degrees C., and even beyond that point it loses its mechanical strength very slowly until past 220 degrees.

The explanation for the resistance of cloth, varying as it does, is exactly similar to that for paper.

OILED PAPER.

In this class 14 tests were made, on papers of different thicknesses. With the single exception of one specimen (the resistance of which was very high), the initial resistance was lower than in the case of paper. (Compare Figs. 2 and 5.)

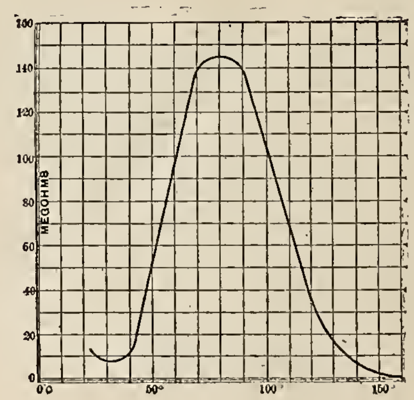


FIG. 4.

On increasing the temperature the resistance fell rapidly, the curve being much the same as that for japanned paper. The reason for the sudden decrease in resistance is the same as that for japanned paper.

Oiled paper deteriorates mechanically at a lower temperature than paper or cloth, commencing to blacken at so low a temperature as 120 degrees C.

OILED CLOTH.

In this class 28 specimens of oiled silk, muslin and linen of various thicknesses were tested. The initial resistance of this material is much lower than that of paper, and on increasing the temperature the resistance falls rapidly, the

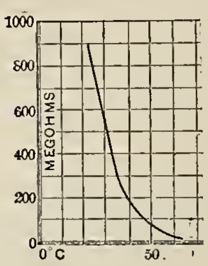


FIG. 5.

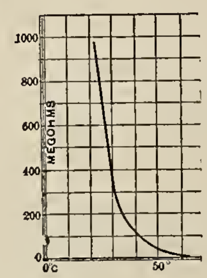


FIG. 6.

shape of the curve (Fig. 6) corresponding to those of japanned and oiled paper; the reason for the sudden decrease in resistance undoubtedly being the same as for the japanned and oiled paper. The insulation begins to char at about 120 degrees C.

GENERAL CONCLUSIONS.

In the foregoing discussion there are some main points to which it is necessary to draw attention. These are:

(*a*) That paper is a better insulation and withstands increase in temperature much better than cloth (shellac and varnish were not used in any of the experiments), oiled paper or oiled cloth.

(*b*) That paper and cloth have a maximum resistance when first heated at about 75 degrees C. and are not injured mechanically under 180 degrees C.

(*c*) That the point of maximum resistance for paper and cloth (in this case 75 degrees C.) depends on the rapidity with which the temperature is increased.

Here the authors would like to suggest that if the material were kept at a constant temperature until all the moisture had been evaporated, the resistance of the material would then be its *true* resistance at that temperature.

(*d*) That all give a high resistance after cooling, but have little mechanical strength.

Oiled paper and oiled cloth, however, after having been heated to 220 degrees C. and allowed to cool, not only have a high resistance, but became so firmly fixed to the brass cylinders that it was found necessary to remove them with a file.

(*e*) That it would be well to bake paper and cloth insulation to 140 degrees C. before applying varnish or shellac.

(*f*) Referring to Fig. 3 it will be seen that on decreasing the temperature the resistance increased, but the second curve does not by any means coincide with the first. On further experimenting in this direction, it was found that there is no temperature at which the curve with falling temperature coincides with the first. This may be due to more moisture being driven out at higher temperatures which is not absorbed by cooling.

Here it may be well to mention an interesting phenomenon that occurred in connection with this investigation.

When the temperature has risen above 100 degrees C., the zinc in the brass cylinder begins to leave its surface and combine with the copper wire wrapped about the insulation, so that the wire has a brass surface and the brass cylinder a copper surface.

Owing to the limited time at the authors' disposal they were unable to further pursue this investigation, but much remains, and any research along this line will be found full of theoretical as well as practical interest.

RAILWAY NOTES.

(*Concluded.*)

On the second day's session, March 19, there was a fuller representation, as follows:

Dallas City Railway, Houston City Street Railway, Galveston City Railroad, Ft. Worth Street Railway, Laredo Electric and Railway Co., Austin Dam and Suburban Railway Co., Austin Rapid Transit Railway, and the Queen City Railway of Dallas.

The president presented extracts from the Connecticut and Massachusetts Railway Commissioners' reports, which in general show: That there has been a slight increase in the income for the year ending September 30, 1895, and considerable decrease in cost of operation; but that the cost is still, in the lowest case, 6893/100 per cent.; in the highest, 7613/100 per cent. Of the 85 roads in the list, which includes St. Louis, only 46 have paid dividends.

ELECTROLYSIS:—Several instances were given of supposed destruction by electrolytic action; in few of the cases could this be definitely traced, nor was there any united opinion as to plans of overcoming the trouble. It was the general opinion that heavier bond wires were necessary. Messrs. Hayward, Urie, Hendricks and Wakefield all gave instances of trouble; in one case a six-inch condensing pipe had been perforated, but was afterwards encased in the tunnel and so far with good results. In another case water-pipes had been badly damaged, but no main pipes. In another, service pipes only had been damaged and the water superintendent advised connecting to the water-pipes direct. In another city the water superintendent refused to allow such connection. In one city the electrician had recommended that they encase the service pipes in vitrified clay sewer pipes. Some discussion was had upon the plastic bond; only one member seemed to have much knowledge of it, Mr. Young, of Galveston; he advised its use and maintained that it was not affected by the up and down movement of the rails that it joins.

REPAIRS OF TRACK.—Messrs. Hayward, Drake & Hendricks advocated the heaviest rail possible. Wr. Wakefield: "Will not the investment reach a point where it ceases to be economical?" Mr. Hayward: "The difference in cost, at the present price of rail, between 35 lb. and 75 lb., would be $1,700 per mile only; add to that about 10 per cent. more for labor and handling."

Mr. Drake: "The labor and the mere handling of the rail is a small percentage of the total expenditure for labor."

Opinion general that the "T" rail was proper except where paving-blocks were used; and the opinion of the majority was that even then the "T" rail could be so blocked as to prevent trouble.

The President: "I think the city authorities in general are rapidly coming to the opinion that the "T" rail has not the objections that have been formerly urged against it.

Mr. Hayward cited a case where "T" rail was specified for macadamized streets. "It costs from 10 to 15 per cent. less than girder, especially when you consider the difference in the cost of fittings, connections, etc."

Mr. Sinclair: "The salt air in Galveston corrodes our rails rapidly, no matter what the weight; but we find that the labor of keeping up the joints of light rail is enormous." Attention was called to a new joint being used on a steam railway, and said to have some merit.

Mr. Drake: We find that the difference between the 25 lb. and the 60 lb. rail is more than saved in truck and car body repair account. Mr. Hendricks suggested that a quicker stop could be made on heavy rails than on light; he advised ties close together.

OVERHEAD WIRES:—A "T" wire reversed was talked of and a cut shown. Mr. Hendricks: "I saw this in the midst of a sleet storm, and it did not seem to be affected by the extra weight more than other wires, and because of the fastening, arcing and consequent pitting of the trolley wire will be prevented at the ears.

Mr. Young: "Regarding the bi-metallic wire, it is guaranteed to have a tensile strength of 5,164 pounds. Size, 00. Weight, 60 lbs. less than copper. Has a steel core. Cost about half that of copper. The general opinion was, however, that a No. 0 hard-drawn copper was standard.

MOTORS:—As to the life: Experience of Messrs. Hendricks and Wakefield, armature life, two years. Mr. Sinclair, of Galveston, one year.

Mr. Drake: Our armature man showed me where armatures had become crystallized, probably by heat or overload. General opinion was that overload was the principal cause of the destruction of armatures.

POWER:—The price of coal was found to be $3.65, $2.50, and $4.10 in front of boilers. The mileage of cars per day was from 100 to 180. Nut and slack coal mixed was used, excepting in one case, where Arkansas was used.

CAR BODIES:—One member had built new and repaired several car bodies; does not advise building new ones locally.

INSURANCE:—Discussion under this head covered a wide range. Briefly, the insurance companies were charging from 2 per cent. to 3½ per cent. on frame power-house buildings and cars on track and in shed attached; from that on down, according to the building, until in detached brick car house the price is 1¼ per cent.

Mr. Drake suggested the organization of the Texas Street Railway Mutual Insurance Co. That 10 per cent. of the gross earnings of each line, together with the regular insurance charges, according to board rates, be paid into the treasury annually; that a certain percentage be kept in reserve. With the rest of the money employed, after $100,000 was in the treasury, a corporation can be regularly organized. Until that, all payments would have to be upon honor. A permanent committee on insurance was appointed, as follows: Carl F. Drake, of Austin, chairman; H. C. Chase, of Houston City Railway Co.; J. L. Sale, of Dallas.

Velocity of Light.—Light travels with uniform motion in any homogeneous medium so long as its density and temperature remain constant, but its velocity differs for different media. Michelson found by experiment that the velocity of light in the atmosphere at the surface of the earth is 186,300 miles per second, which corresponds to a velocity of 186,373 miles per second in the ethereal medium. The velocity of light in crown glass is 122,614 miles, and in flint glass about 113,600 miles per second.

EVOLUTION OF INTERIOR CONDUITS FROM THE ELECTRICAL STANDPOINT.

BY LUTHER STIERINGER, M. I. E. E.

The fact that a conference, organized under the auspices of this Association to secure better electrical construction, was held recently in this city, is in itself an evidence of the importance attaching to the general subject. But the national and influential character of the bodies represented is further proof of the anxiety felt in regard to the matter, and the desire for a higher grade of work. In particular does that feeling concern interior wiring for buildings of all kinds. There is a feeling that the future and prosperity of electricity depend on the methods by which current is introduced into and distributed through modern offices, modern houses, and modern halls. It is felt that, in many respects, electricity has reversed the methods of road-making. In almost every city the roads are fairly good; in most they are excellent. When you strike the country you are likely to find boggy, rocky, uneven tracks and paths, which cause disaster to the buggy and the bicycle. In electrical practice, we have got our main roads in pretty good shape; but when we come to the city line, or, in other words, to the confines of the building, there we begin to strike the wildest and strangest vagaries in the plan and construction of paths for the current that can possibly be conceived. Where the electrical road building, or, as the French say, "canalization" should be best, it is worst. Let us examine the problem thus disclosed with the object of finding a plan of improvement. Let us see where the art of interior wiring started, the point it has attained, and the end at which it should be aimed.

Webster defines a conduit as a pipe, canal, channel, or a passage for conveying water or fluid.

According to the standard rules (National Board of Fire Underwriters, 1896,) the object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury, and, as far as possible, from moisture. Tubes or conduits are to be considered merely as raceways, and are not to be relied on for insulation between wire and wire, or between the wire and the ground.

In the development of interior electrical distribution it is necessary to briefly review the history of the use of the conduit for water, gas, and steam, especially before the introduction of the powerful electric currents necessary to supply light and power.

GAS FITTING.

In the early gas installations in England lead pipe was used quite extensively. The work was performed at that time by the plumber. The term "gas-fitter" originated and became a special trade name in the United States, when iron fittings were introduced. Prior to that stage in the art, fittings were improvised by brazing a saddle of brass on a piece of iron pipe. This saddle had a protuberance threaded with a male thread, and after being brazed to the pipe, was drilled for a gas way, thus forming an outlet to which a coupling could be attached. The present form of gas fitter's tee is an equivalent of what has just been described. Lead was never employed in the United States for gas piping, except for meter connections and temporary work.

In one of the earliest gas systems in Philadelphia, in 1835, iron mains were run on the outside of the houses, with stop-cocks arranged so that the gas might be turned off before the family retired for the night. This was thought necessary for security, on the supposition that otherwise some unknown cause might develop leaks or trouble. In France, at one period, all gas piping in interiors was left exposed for more ready inspection. The crude methods of installation in that day did not inspire confidence in concealed pipes.

Service stop-cocks are still placed near the street curb, as a provision principally against fire, in case the meter or other connections in the interior of the buildings be melted or dislocated and the escaping gas continues to do damage.

On the Continent of Europe there is generally a main tap on the exteriors of premises attached to the service pipe, for the purpose of shutting off the gas when desirable.

At the time of the famous Barnum Museum fire on Broadway and Prince street, New York, the inability of the firemen to get at such service cocks, owing to ice-covered débris, permitted the escape of gas inside of the building line to such an extent that the volume of flame rivalled a burning gas well. This continued for several days before it could be controlled.

Escaping gas is more dangerous than any other medium distributed in a building. Many years of experience have proved that the use of iron piping to convey gas has minimized all possible dangers from leaks or other causes. The early fitting art, by its use of split dies and poor material, was responsible for any lack of confidence as to the ability to confine water or gas to the conduits or pipes.

The reliability of gas, water, and steam conduits in interiors, and the general public confidence in them today, can be traced to the creation of the solid die for cutting threads to proper fittings, to superior pipes, and to standard threads.

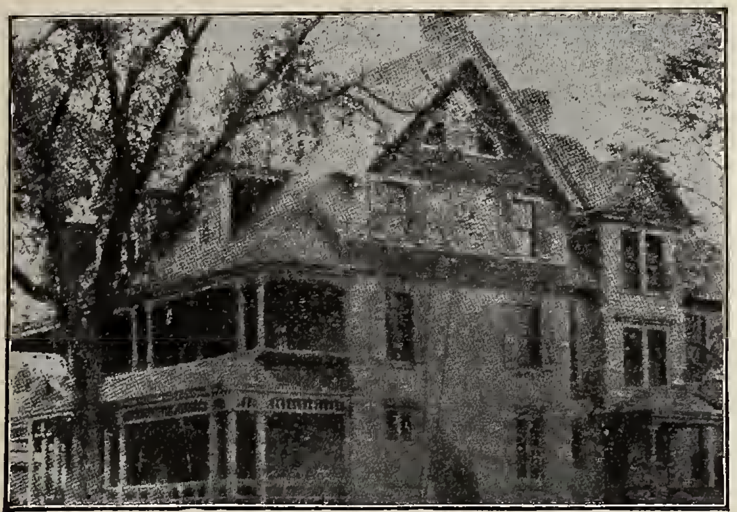
(To be Continued.)

In a systematic study of possible economies with a view to reducing the cost of production, a young and clever engineer employed in a manufacturing establishment near New York lately hit upon an idea which might be adopted with advantage by manufacturers in all lines. Convinced that the large economies had been well looked after, and that his greatest usefulness lay in the discovery of opportunities for small savings, the young man made a diagram showing the ground plan of the works. On this diagram he traced, in colored lines, the course of the various materials employed in the industry. The results were surprising. The path of each material entering into the finished production of the works suggested nothing so much as an admiralty chart tracing the course of a derelict at sea. Instead of moving steadily from stock pile to shipping room it was found that the material zigzagged around the works, twisting, turning, and doubling on itself until its path was 12 or 15 times the greatest length of the plant. Obviously this meant unnecessary handling. Looking more closely, the investigator discovered that instead of being a continuous process the business consisted of half a dozen or more separate processes, each in the hands of a little group of workmen whose special skill had for years been overvalued, but who had taken good care to see that no one of their number set a pace which the others found inconvenient. Over each of these groups was a foreman, whose ambition it was to erect his branch of the industry into a distinct department. To this end he had got it as much as possible by itself, and was not satisfied until he had a closed door between his room and the one adjoining it. No one realized the evils of this system until the diagram of which we have spoken made it evident at a glance. To effect the reform needed, recourse was again had to the graphical method, and it was found that with very little expense the amount of moving and handling of material in process of manufacture could be reduced one-half. One or two new doors were cut, and the machinery was rearranged with a view to bringing the several processes as nearly as possible into line. As a result it was found that a good deal of the unskilled labor formerly about the works could be dispensed with. It was further found that the problems of the management were materially simplified, and that the unequal working of the several departments was early and permanently corrected. What had been half a dozen processes became one continuous process. By a discreet shifting of labor the special skill of each little group of mechanics became common property, and the cliques which had been a brake on the wheels of the industry were effectively broken up. The weekly pay-rolls were materially reduced, the output was increased in quantity, and improved in quality, and a very pronounced tendency to "dry rot" was checked and corrected."—*Iron Age.*

FRANKLIN LEONARD POPE.

IN MEMORIAM.

On October 13, 1895, in the picturesque village of Great Barrington, that nestles like a gem amidst the grandeur

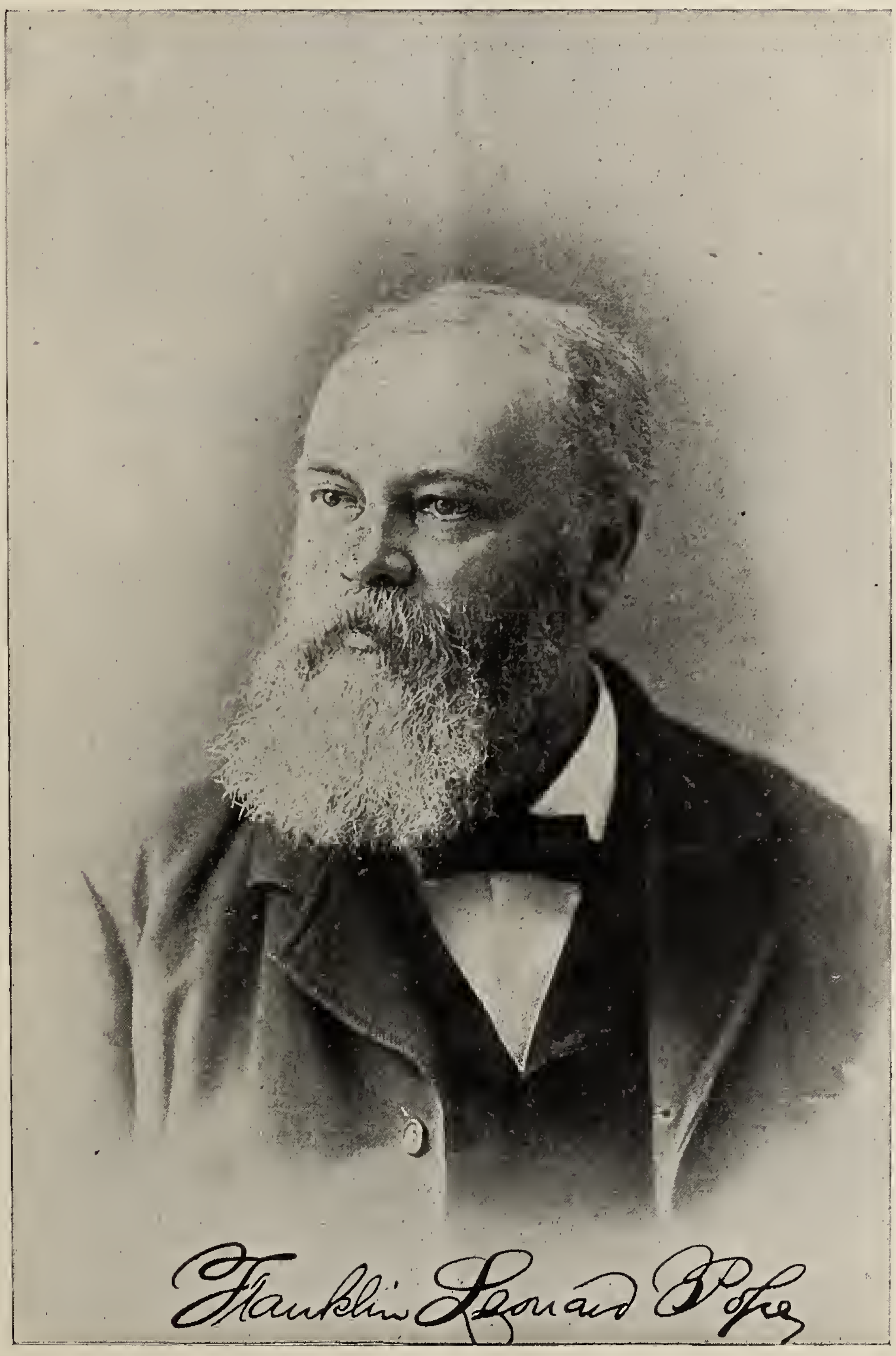


WAINWRIGHT HALL,
(BUILT 1776 REMODELED 1890.)
Corner South Main and Pope Streets, Great Barrington, Mass.

and beauty of the Berkshire Hills of Western Massachusetts, there occurred one of the most tragic events that has so far attended the development of electric energy. In this, his birthplace, and scene of his childhood, Franklin Leonard Pope, at the age of 55 years, passed beyond the boundary that separates the 5nown from the unknown. In the very prime of life, at the zenith of a most honorable and useful career. he was instantly stricken down by the mysterious electric agent that he had so thoroughly studied, and assisted to guide into the service of mankind at an early day, when but little was known of its subtle and useful possibilities.

Mr. Pope was born on December 2, 1840, a descendant of Thomas Pope, the Pilgrim, who settled in Plymouth, Mass., 1631, and died in Dartmouth, 1683, and it was the hereditary strain of Puritan energy that dominated Franklin Leonard, the subject of this fragmentary and inadequate sketch. His birth was almost coincident with the introduction of railroads and telegraphs, and so keen were his faculties of observation and interest in mechanism, that, when a small boy, he made from memory water-color drawings of all the locomotives on the Housatonic Railroad. Those pictures were such faithful reproductions that Mr. Peleg Bronson, one of the engineers of that road, employed Master Pope to make a water-color picture of the locomotive "Lee." Thus his first earnings were due to the early development of his artistic taste, which was a characteristic trait throughout his career. It seems that the Christian name "Franklin" was singularly prophetic so far as Mr. Pope's tastes for scientific research were concerned.

After receiving such limited education as the common school of his native village afforded, supplemented by a term at the academy in Amherst, Mass., we find him at the age of 17 favored by the unsolicited appointment as



operator in the Great Barrington telegraph office, and shortly afterwards appointed circuit manager of the Boston and Albany railroad wires at Springfield, Mass., as he soon attained considerable reputation as an expert operator of the Hughes printing instrument.

About the close of 1859, Mr. Pope was given a position in the drafting department of the *Scientific American* in New York city. Here he found scope for his natural talents as a draftsman, and at the same time acquired an insight into patent law and the preparation and prosecuting of applications for patents, a knowledge that he afterwards turned to good account.

Mr. Pope re-entered the telegraph service in Providence, R. I., as an operator, in 1861. There he displayed his drafting skill by making a complete map of all the wires and routes between Boston and New York, which was brought to the attention of General Marshall Lefferts, Engineer-in-Chief of the American Telegraph Company, who promoted him to a more important position in New York, where a larger field of usefulness opened out before this ambitious young man. During the draft riots in New York, in July, 1863, the telegraph wires were cut down by rioters, leaving the city in telegraphic darkness at a very critical moment in our country's history. Mr. Pope was assigned by General Lefferts to the duty of restoring communication between New York and Boston. The lines were found destroyed in many places along the railroad between Williams Bridge and Forty-second street, New York, and also in the southern portion of Westchester County, all that territory being under the surveillance of the rioters. Mr. Pope disguised himself as a farm laborer, and with a portable telegraph instrument and repairing tools concealed in a sack of oats, started from New Rochelle, and protected by a dark, foggy day, walked over the fifteen miles between that place and Harlem River, and during the succeeding night connected up one of the fragmentary wires and restored telegraphic communication to Boston, notwithstanding he had to run the gauntlet of the enemy's pickets. At one time during the night he was captured, but so well did he play his role of a rustic, that he was liberated unharmed; at another time, a little later, he was attacked at a point near Morrisania by a gang of at least fifty rioters, armed with knives and pistols, but he eluded his assailants in the darkness by concealing himself in a cornfield until he was able to proceed unnoticed and complete his dangerous task. The single wire, so connected, ran along fences; under station platforms, and was carried mainly by trees and bushes close to the ground, so that it was not distinguishable from the wrecked wires cut from their regular supports on poles. Thus was restored an unsuspected avenue of telegraphic communication that was of great public importance.

At the close of 1863, the telegraphers of the United States formed the National Telegraphic Union, of which Mr. Pope was the New York district secretary. This society established a monthly publication, *The Telegrapher*, which, besides the aims and interests of the Union, was largely devoted to telegraphic history and progress, and contained many valuable and selected articles. Mr. Pope was the first contributor, under the pseudonym of "Elektron," of original researches upon batteries, repeaters, insulators and kindred subjects, in which connection the editor in the issue of April 25, 1865, says: "The series of articles upon "'The Telegraphic Repeater,' which has occupied the first "page of several numbers of this paper, are brought to a "close in this issue. The writer of them (Major Pope) has "done a signal service to our readers, the telegraphic pub-"lic, the inventors and ourselves. Never before has the "subject been printed. The diagrams were put upon the "wood by Major Pope, who has besides all this contributed "freely to other columns of this paper, and will be its cor-"respondent from the Collins' overland expedition, whence "he sailed in company with Mr. Cran, on the 3rd instant, "on the steamship 'Ariel,' via the Isthmus."

Several illustrations of Mr. Pope's cleverness at designing and drawing are to be found in *The Telegrapher's* pages, one of which appeared at the head of its editorial columns on November 28, 1864, and another, the heading of the first page. This was designed to be symbolical of telegraphy, and is explained by the editor as follows: "The great joy of the 'owl' in the vignette, while sending "his last message at midnight, can be readily understood "by those whose misfortune it is to see the day die and "come to life again, as they wearily drag themselves home "from a night's exhausting work. The scene at the right "is the interior of an office containing those wonders of "telegraphy—the printing instruments. Those who have "witnessed the excitement caused by news from the war "can understand the pictured scene at the left." [A crowd around a bulletin board.]

The overland telegraph, connecting San Francisco and adjacent territory with Chicago and the East, was completed in October, 1862, and the California State Telegraph Company had shortly afterward connected San Francisco by wire with New Westminster, in British Columbia.

Owing to the failure of Cyrus W. Field's 1858 cable under the Atlantic ocean, a project equally as stupendous was conceived by Perry McD. Collins, to connect the new and old worlds by the electric wire, via New Westminster northward through the Arctic region to Behring Strait, over 2,500 miles, crossing the Strait by a submarine cable about 178 miles in length, thence by overland wire through Russia to Moscow, about 7,000 miles. Owing to the extremely irregular Pacific coast line between Vancouver's Island and Cape Prince of Wales—deeply indented with ragged fiords, flanked by abrupt mountain ranges and spurs that stand sheer to the sea, beetling o'er their base and looking many fathoms down, it was necessary to find an interior route through British Columbia and Russian America (now Alaska), to Behring Strait. This region was nearly as trackless and vast as the ocean, with but vague accounts of the topography of a very limited portion gained through Indian hunters.

The Western Union telegraph directors in 1864 organized the Western Union Russian Extension Company to carry out this gigantic enterprise, of which Colonel Charles S. Bulkley, who had been superintendent of military telegraphs in the Gulf Department, was appointed engineer-in chief, and Mr. Pope assistant engineer and chief of the Geographical department. Among the preparations for the expedition to explore the country and construct lines through a region, the most of which was wholly unknown, it was necessary to make a very exhaustive study of all the existing charts, maps, books and other printed matter relating to British Columbia and Russian America. From these meagre sources, dating back to 1779, were compiled some important maps for the use of the leaders of the expedition. Mr. Pope executed on the polyconic plan a large map containing portions of the two hemispheres in a manner never before shown. Eminent geographers of that day considered the map a *chef-d'œuvre* of drafting, and the most accurate map extant.

Mr. Pope was detailed to explore the wildest and most inhospitable portion of the territory between the head of the Fraser river in British Columbia and the Yukon river in the heart of Russian America, a distance of 1,500 miles, and in view of his qualifications for so important an undertaking, he was commissioned with the rank of major by Governor Andrew, of Massachusetts, and attached to his staff.

(*To be Continued.*)

Flying Machines.—Octave Chanute of this city, ex-president of the American Society of Civil Engineers, made experimental trips with a flying machine about 30 miles south of this city, on Tuesday last. The apparatus was modeled after one invented by Otto Lilienthal of Germany. It is described as in appearance "like six pairs of birds superposed," made of oiled nainsook silk stretched over a spruce and willow frame, 15 feet long and 14 feet wide, weighing 32 pounds. It was raised into the air and went sailing over the valley to a considerable distance, and came down without accident. The problem of a motive power to propel it has not yet been solved.—*Industrial World.*

SPECIAL DRILL FOR MODERN ELECTRICAL SHOPS.

PRENTISS TOOL AND SUPPLY CO., 117 LIBERTY ST.

The cut represents the latest pattern 24-inch drill, which was designed especially for rapid work on electrical machinery, and also for the manufacturing of machine parts where jigs are used to accurately drill and ream irregularly placed holes. It is so arranged that two or more drills can be used in a row. The drills can be set 30 inches apart, allowing ample room for changing belts. The countershafts will be parallel with line shaft.

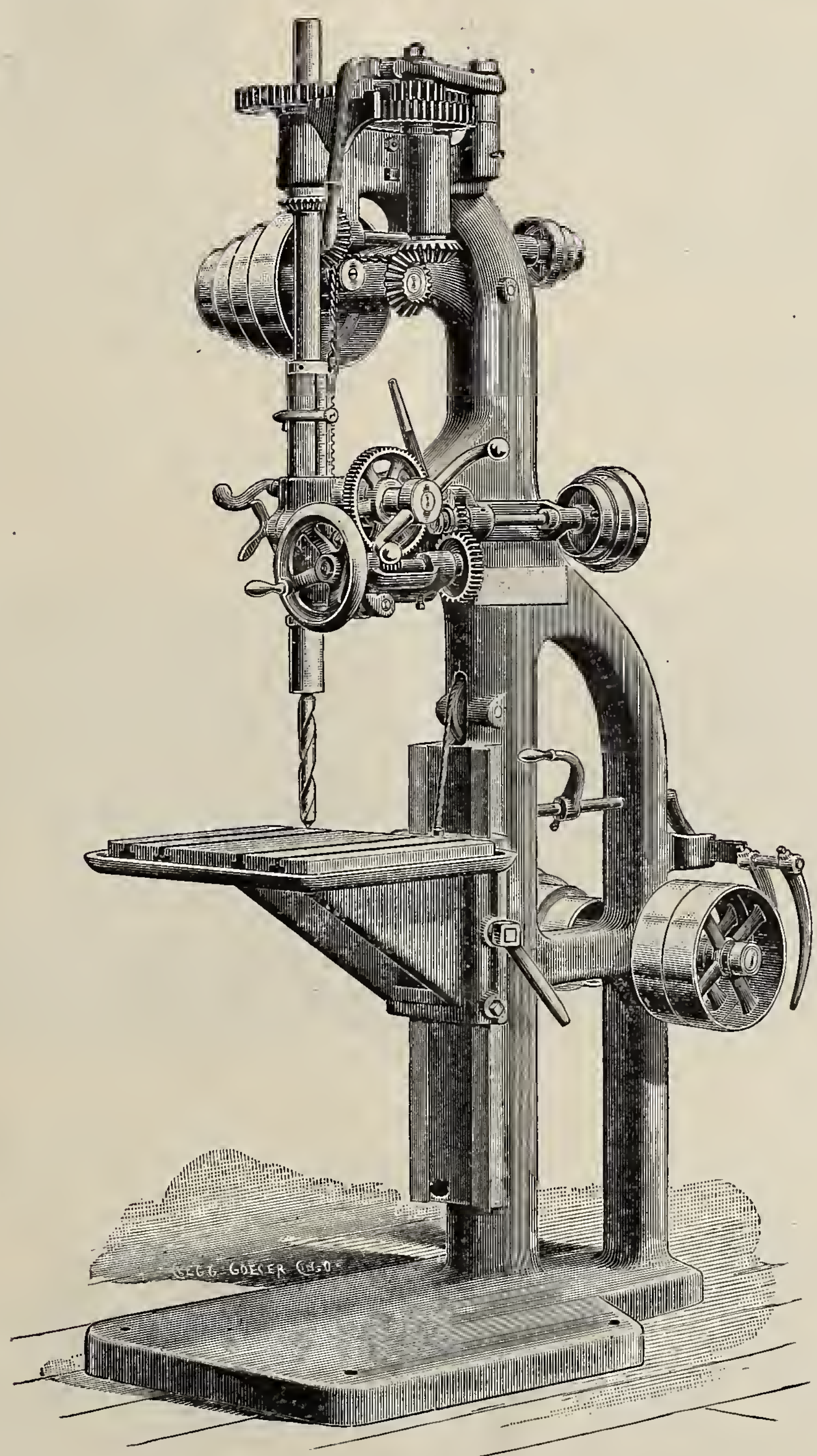
The back gearing can be engaged while the spindle is revolving. The handle by which this is done is within easy reach of the operator. This handle can also be used to stop the spindle revolving.

The feed operated by hand or power, also the quick return and approach motion and the automatic stop, are simple, powerful, quick-operating and entirely new. The drill can be instantly engaged, and after the automatic stop has done its duty the drill can be returned without loss of time from unscrewing friction disks, or clutch arrangements. The automatic stopping is done by releasing the worm from the worm-wheel. The worm, which is on a swiveling shaft, is always revolving; it fits exactly in the worm-wheel and can be quickly and easily engaged to same by a conveniently placed hand-lever.

The sprindle is counterbalanced and works on anti-friction ball-bearings. The table is square; it is arranged with T slots and an oil channel, which is tapped for half-inch pipe to drain off the lubricating liquids. It is also counterbalanced, works easily on the column, and can be clamped by tightening the bolt which presses on the V-shaped gib.

SPECIFICATIONS.

Size of table..................	18x20 inches.
Ratio of gearing..............	1 to 8½ inches.
Vertical adjustment of table....	16 inches.
Diameter of spindle...........	$1\frac{9}{16}$ inches.
Number of Morse taper.........	4
Feed of spindle...............	10 inches.
Tight and loose pulleys........	10x3 inches.
Speed of countershaft, per minute	250 revolutions.
Weight, about................	1,150 pounds.



PRENTISS DRILL.

The lathe has a dovetailed slide fitted into rest with packing, by which to take up the wear. The tool post shoe travels on this slide, which is extended back and connected with a guide block fitted to an adjustable, graduated guide-bar. This bar is held in position by an adjustable bracket fitted to T slot on bed. To connect slide, remove taper pin in back side of rest and fasten slide to guide block with collar screw.

If the lathe has power cross feed, be sure to drop intermediate gear in apron out of slide before connecting it. The rest screw is free to adjust the tool at all times.

The guide block has a travel of 18 inches, and with adjustable bracket the taper can be obtained on any part of the bed. This attachment will turn a taper of 3⅝ inches to the foot.

This lathe is made in the most thorough and workmanlike manner of the best materials. All bearings are scraped to a fit and all the lathes are thoroughly tested before leaving the works.

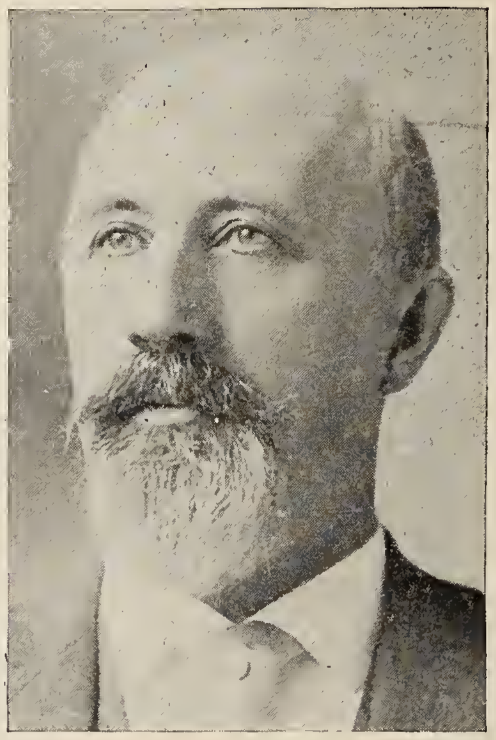
The head spindle is of crucible steel and runs in bearings of the best box metal, there being no Babbitt bearings in the lathe. Length of spindle, 20¾ inches; diameter of front bearing, 2⅛ inches; length of front bearing, 3⅞ inches; diameter of back bearing, $1\frac{1}{16}$ inches. ¾ inch hole through spindle with No. 3 Morse taper for centres. The head is geared 8 to 1. Diameter of largest section of cone, 8⅝ inches; diameter of smallest section of cone, 3⅜ inches; width of belt 2 inches.

This combination makes a very powerful head for a 13 inch lathe. The tail spindle is of crucible steel, 1½ inches in diameter, and has a travel of 5 inches. Both tail and rest have long bearings on the bed, thus obviating any tendency to spring.

Swings over bed, 13 inches; turns 26 inches; 5 foot bed; swings over raise and fall rest, 6½ inches; swings over plain gib or compound rest, 8 inches. Weight, 1,150 lbs. Weight per extra foot, 70 lbs.

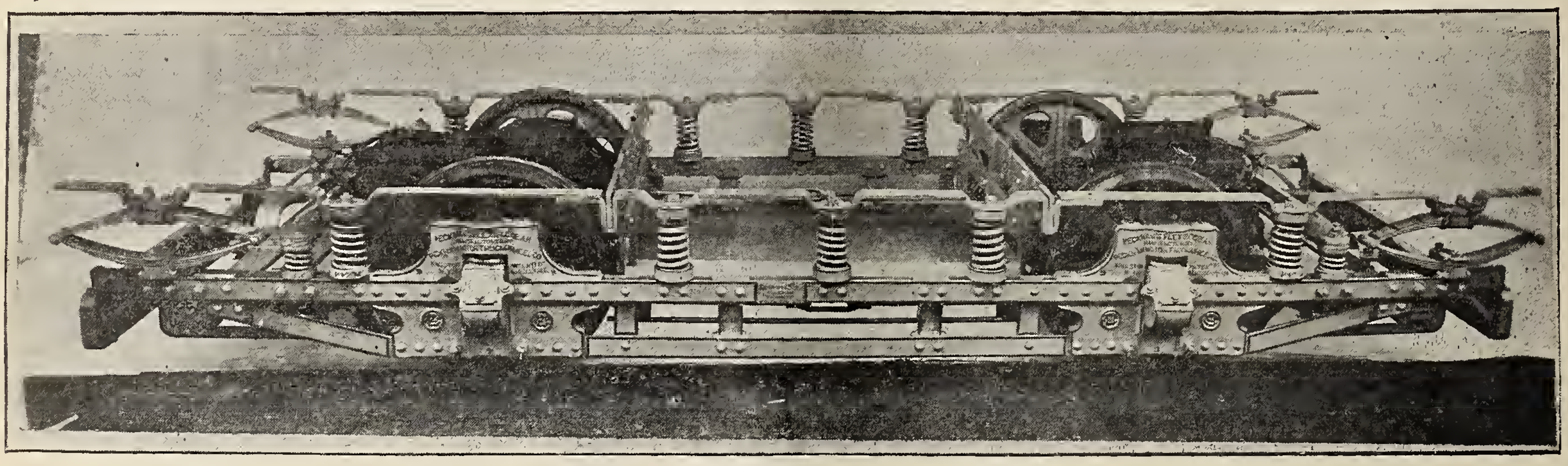
PECKHAM MOTOR, TRUCK AND WHEEL COMPANY.

We are glad to say that Edgar Peckham, president of the Peckham Motor, Truck and Wheel Co., returned from California last week safe and sound. The trip he took for his health was quite extensive. It was undoubtedly a source of pleasure to Mr. Peckham to greet some of his enthusiastic friends. He stopped at all the principal cities on his way home and did not look very far for company. It clustered around him. The Electrical Street-Railway Companies of America all know him. His efforts to bring his department of railway work to a state

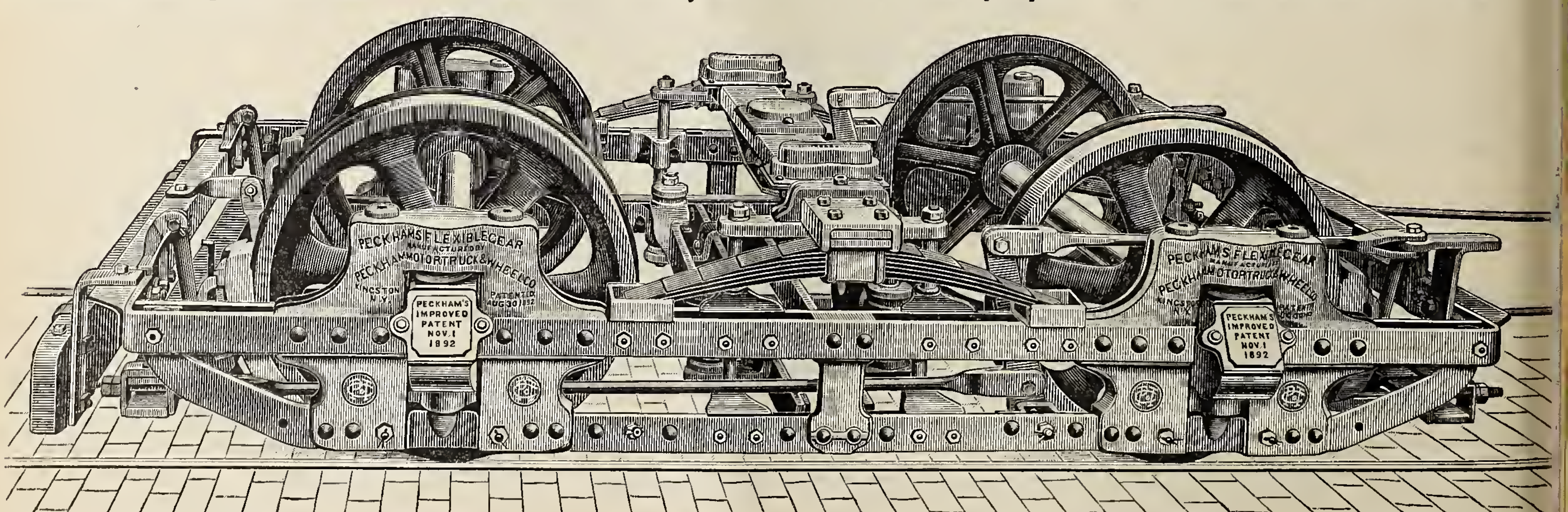


EDGAR PECKHAM, PRESIDENT
Peckham Motor Truck and Wheel Co., New York.

of perfection has gained for him the good-will and popularity he so richly deserves. Mr. Peckham has been the means of assisting electric traction enterprises a great dea more than most people think. What he does not under stand, appreciate and know about trucks is not worth knowing. His natural abilities, backed up by pluck, energy and enterprise, have enabled him to struggle to the front and



PECKHAM'S EXTRA LONG TRUCK FOR STORAGE BATTERY CARS.



PECKHAM'S SWIVEL OR BOGIE TRUCK FOR HEAVY TRAFFIC.

stay there. The needs of street-railway corporations would have required seven volumes to enumerate when he turned his benignant eye upon them. About twelve years of hard labor, studying, improving and developing that most valuable of all additions—a good truck—has given him prestige with all. The stock of electric roads was very low when the experiments were well under way. Mr. Peckham never hesitated in taking off his coat to show the striking points of superiority in his truck and why it is so popular. It is the standard of this country. This enthusiastic desire to bring out a good article has eventuated in his great success. The Peckham truck is identified with Mr. Peckham, the inventor, and the strength and firmness of one is only duplicated by the same characteristics in the other.

New Corporations.

New York City.—The New York and Queens County Railway Co. has been incorporated with a capital of $2,500,000. This company is a consolidation of the Steinway Railway Co. of Long Island City, the Newton Railway Co., the Riker Avenue and Sanford's Point Railway Co. and the Flushing and College Point Electric Railway Co. Directors, Rudolph T. McCabe, Benjamin Orme, of New York City; Edward T. Stotesbury, Caleb F. Fox, William Shelmerdine and R. E. Gowen, of Philadelphia.

Wilkinsburg, Pa.—At the next meeting of the Wilkinsburg Council that body will be asked to give the right of way over several of the borough streets to a new electric road known as the Wilkinsburg and East Pittsburgh Electric Railway. A company has already been organized. William M. Brinker, president; A. W. Duff, W. O. McNary and J. J. Jennings, directors. Capital stock, $150,000.

Middletown, N. Y.—The stockholders of the Beaverhill Telephone Co. have voted to increase their capital stock from $1,500 to $4,000, and to extend their line from Roscoe to Livingston Manor and from Lew Beach to Margaretville, Delaware County.

East Liverpool, O.—Work on a new telephone line between East Liverpool and Burgettstown will commence soon. The wires will be strung to Salineville in a short time.

Oxford, Me.—The Oxford Electric Light Co., organized at Mechanic Falls, for the purpose of generating and distributing electricity for mechanical purposes. Capital, $5,000. President, W. A. Greenlaw, of Berlin, N. Y.; Treasurer, H. C. Rowell, of Berlin, N. H.

Delta, Pa.—An application will be made July 7 for the incorporation of the Delta Electric Power Co., the main purpose of which is to supply power, heat and light to business enterprises in and around Delta. Capital, $30,000.

Brookville, Pa.—The Brookville Railroad Co., with a capital of $130,000, has applied for a charter for the purpose of building a railroad from Brookville up the North Fork, thirteen miles, into a large timber tract in Polk Township.

Possible Contracts.

Portsmouth, O.—At the meeting of the council, Mr. Bratt, of the Light Committee, reported that complaints of insufficient light were due to the fact that the dynamo was incapacitated to furnish the desired quantity and quality, and his committee was authorized to ascertain the price of a new dynamo.

West Chester, Pa.—The Trustees of the State Normal School held a special meeting for the purpose of taking action on a proposal to put in an electric light plant. They decided to have the plant constructed and ready for use by the time the stndents return in the fall. It will cost $10,000.

New Brighton, S. I., N Y.—The Staten Island Electric Railway Co. has filed a certificate of extension of its road in New Brighton, and the town of Northfield, Richmond County, with the Secretary of the State, at Albany.

NEW TELEPHONE COMPANIES.

Palmer Lake, Col.—The Colorado Telephone Co. has applied for a franchise in Palmer Lake, to put up poles and wires.

Waucoma, Ia.—The Union Electric Telephone Co. will build, equip, operate and own telephone lines. Capital, $100,000. Incorporators, J. F. Cass, L. S. Cass, Chas. Webster, Asa Webster, Thomas A. Way and T. A. Potter.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued June 2, 1896.

561,107. Door-Lock Switch for Electric Lights. William E. Goucher, Jamestown, N. Y. Filed Jan. 2, 1896.

561,116. Electric Switch. Frank Land, Syracuse, N. Y. Filed June 19, 1895.

561,124. Electric Target Apparatus. John L. McCullough, Brooklyn, N. Y. Filed Mar. 13, 1896.

561,128. Trolley-Switch. Moses Rangey and Peter Plante, Schenectady, N. Y. Filed Jan. 17, 1896.

561,144. Alternating Electric Motor. Joseph A. G. Trudeau, Ottawa, Canada. Filed July 18, 1894.

561,155. Car-Fender. Peter Best, Elizabeth, N. J. Filed July 15, 1895.

561,159. Fusible Cut-Out. Louis W. Downes, Providence, R. I., assignor of one-half to William C. Woodward, same place. Filed Apr. 17, 1895.

561,163. Car-Fender. Frederick J. Graf, New York, N. Y. Filed Mar. 14, 1896.

561,168. Trolley Stand. Frank N. Kelsey, New Haven, Conn., assignor of one-half to Charles L. Wright, same place. Filed Mar. 28, 1895.

561,183. Electric Meter. Addison G. Waterhouse, Hartford, Conn. Filed May 27, 1895.

561,184. Hanger for Electric Lamps. William S. Weston, Etherly, Ill. Filed Mar. 4, 1895.

561,185. Electric-Lamp Hanger. William S. Weston, Chicago, Ill. Filed May 22, 1895.

561,196. Method of Varying Level and Position of Gas, Electric, or Oil Lights. Robert H. Best, Handsworth, England. Filed July 11, 1893.

561,204. Composition for Exciting Fluids for Electrical Batteries. Frank G. Curtis, Philadelphia, Pa., assignor to J. Boardman Cann, Boston, and Frederick D. Goode, Newton, Mass. Filed Feb. 13, 1893. Renewed Nov. 14, 1895.

561,205. Pole-Piece for Electrical Batteries. Frank G. Curtis, Philadelphia, Pa., assignor to J. Boardman Cann, Boston, and Frederick D. Goode, Newton, Mass. Filed Feb. 20, 1893. Renewed Nov. 14, 1895.

561,218. Car-Fender. Henry D. Gardy, Chester, Pa. Filed Sept. 18, 1895.

561,224. Electric Car. John C. Henry, Westfield, N. J. Original application filed Sept. 27, 1889, Serial No. 325,-244. Divided and this application filed Feb. 11, 1893.

561,225. Electric Car. John C. Henry, Westfield, N. J. Filed May 9, 1893.

561,271. Motor-Controlling Device. Charles E. Ongley, New York, N. Y., assignor to George J. Schoeffel, same place. Filed Nov. 2, 1893.

561,272. Electrically-Controlled Steering Device. Chas. E. Ongley, New York, N. Y., assignor to George J. Schoeffel, same place. Filed Dec. 8, 1893.

561,284. Electric Switch. Hiram Ross, Providence, R. I. Filed Feb. 17, 1896.

561,293. Car-Fender. Joseph W. Swarts, Philadelphia, Pa Filed Aug. 31, 1895.

561,294. Electric Heater, Harry A. Thomas, Niagara Falls, N. Y., assignor of one-half to Edward B. Wyman, High-Wood, N. J. Filed Feb. 6, 1895.

561,307. Electric Railway. Henry Brandenburg, Chicago, Ill. Filed May 22, 1895.

561,354. Power Gearing for Electric Cars. Elmer A. Sperry, Cleveland, Ohio, assignor to the General Electric Company, of New York. Filed Feb. 16, 1895.

561,388. Wire-Connector. Alfred Gartner, Newark, N.J., assignor to Charles H. McIntire, same place. Filed Apr. 17, 1896.

561,390. Dynamo-Electric Machine. Alphonse I. Gravier, Paris, France. Filed Apr. 7, 1894.

561,395. Electric Locomotive. William P. Henszey, Philadelphia, Pa. Filed Oct. 4, 1895.

561,397. Flexible Safety-Guard for Street-Cars. Elmer E. Higinbotham, Chicago, Ill. Filed July 8, 1895.

561,431. Telltale for Steering-Gear of Ships. Mathias Pfatischer, Philadelphia, Pa., assignor to the Electro-Dynamic Company, of Pennsylvania. Filed Aug. 12, 1895.

561,433, Street-Car Motor. Benjamin C. Pole, Washington, D. C. Filed Mar. 6, 1896.

561,438. Wire-Connector. Duncan M. Robertson, Kearny, N. J., assignor to Charles H. McIntire, Newark, N. J. Filed Apr. 17, 1896.

561,443. Electric-Lamp Hanger. Joseph Schmidt, New York, N. Y. Filed Feb. 11, 1896.

561,448. Magnetic Medical Apparatus. Augustus B. Slater and Nils A. Renstrom, Omaha, Neb. Filed Oct. 9, 1894.

561,530. Electric-Car Truck. John Taylor, Troy, N. Y. Filed Apr. 29, 1895.

561,547. Automatic Telegraph. Samuel P. Freir, Hasbrouck, N. J., assignor to The Western Union Telegraph Company, of New York, N. Y. Filed Aug. 9, 1893.

TELEPHONE PATENTS.

ISSUED JUNE 2, 1896.

561,335. Telephone-Exchange System. Kempster B. Miller, Wilkinsburg, Pa. Filed Feb. 18, 1896.

561,358. Microphone. George W. Sutton, New Rochelle, N. Y., assignor to the Phœnix Interior Telephone Company, New York, N. Y. Filed Apr. 14, 1896.

561,377. Automatic Telephone-Call. Gerard Q. Dean and John Dean, Jr., New York, N. Y. Filed Aug. 3, 1895.

561,416. Attachment for Telephones. John H. Miller, Washington, D. C., assignor of one-half to Richard T. Meany, New York, N. Y. Filed Mar. 12, 1896.

561,417. Telephone System. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,418. Telephone-Exchange System. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,419. Switchboard for Telephone Systems. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,420. Line-Jack for Telephonic Switchboards. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,421. Telephone Call-Box. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,422. Telephone Call-Signal for Central Stations. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

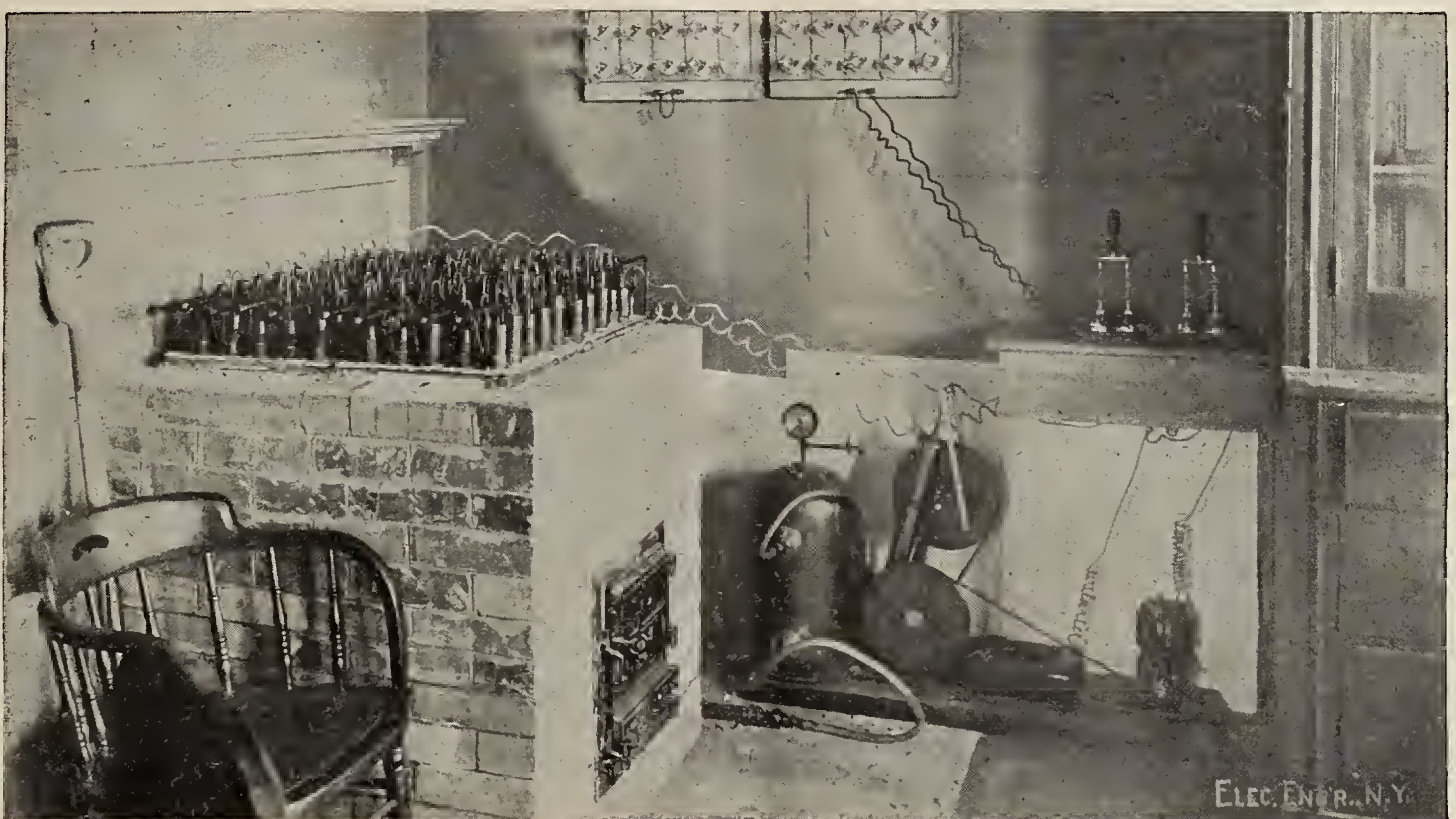
561,423. Telephone. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,424. Telephone Switch-Plug. Paul Minnis, Mobile, Ala, assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

561,498. Party-Line Telephone Apparatus. William W. Dean, St. Louis, Mo., assignor to the Bell Telephone Company of Missouri, same place. Filed Mar. 28, 1896.

The Electrical Age.

VOL. XVIII., No. 2. NEW YORK, JULY 11, 1896. WHOLE No. 478



DR. JACQUES CARBON BATTERY.

ELECTRICITY DIRECT FROM COAL.

A great problem that has for years occupied the attention of earnest workers, is the generation of electricity direct from coal. In a former article on the subject the remarks of Dr. Ostwald were condensed, and the proposition he brought forward as the most definite shape the problem could assume was carefully reviewed. To-day the solution of that great question is near at hand. The production of electricity from coal is now carried on by successive stages. Coal is burnt in a boiler, water heated, steam evolved and engine rotated.

So complex a system is necessarily wasteful. The loss by radiation and friction leave but little in the final transformation. We are wasting coal in thousands of tons a day. How shall we stop it? Under the heading of the following article (Electrical Age, Sept. 8, 1894), some idea at least may be gained of the proposed method:

GREATEST OF MODERN PROBLEMS.

The problem of mankind—the economical production of energy—has been attacked on all sides by some of our most eminent scientists. It is openly confessed that some other method than the mere combustion of a fuel is necessary in order to obtain a greater percentage of its stored energy.

Osmose—hitherto a superficially treated subject—is a rich field for the investigator. The pressure set up by a body when dissolving in a liquid, or a solution when mixing with water, may assume an enormous value.

Common sea water acts with a pressure of 300 pounds per square inch in its tendency to mix with pure water. It is the substance in solution that causes this pressure and is true for all dissolved substances.

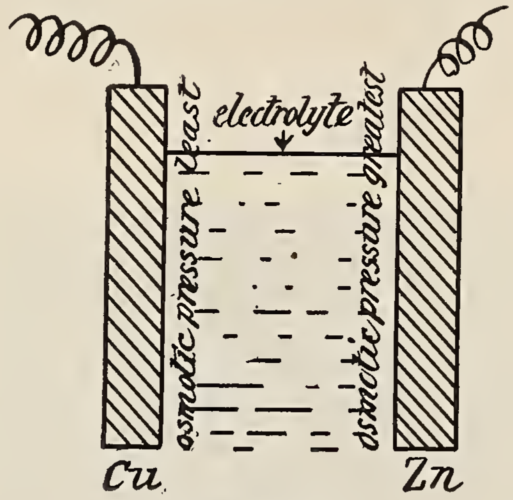
The resolution of the theory of the primary cell to such a basis, places us on a more substantial footing than ever before. Dr. Ostwald shows the parallel relationship existing between osmotic and electrical pressure. In other words, to obtain great E. M. F. from a cell we must select two materials as elements with the greatest difference of osmotic pressures.

As Dr. Ostwald states (The Engineering Magazine, August, 1894): "The zinc and copper of the Daniell cell are two such sources of current of different potential and the difference of their electrical pressure is based on the difference of osmotic pressure with which the zinc ions and copper ions are respectively endowed." A factor that will affect these conditions is the electrolyte. An electrolyte must be chosen whose reactive effect when charged with zinc ions will be least, while for the other electrode it will be greatest. By this means we are best prepared to make the most efficient combination with the elements at our command.

In this introduction to the subject of coal consumption the inefficiency of a steam plant, the loss of 90 per cent.

of the energy of the fuel is due to the difference in temperature between the fire and boiler.

Upon presenting this fact to our recollection, Dr. Ostwald points out a method for obtaining the chemical energy of the coal without heat. He shows that the application of an acid to the zinc in a zinc and platinum cell is not productive of the greatest E. M. F. The greatest elec-



IDEAL ACTION.

trical effect is produced by the acid being applied to the passive electrode.

From this principle he contemplates the possibility of oxidizing coal, not by the oxygen in direct contact with the coal, but by the interposition of an inconsumable electrolyte. By this unexpected means the entire chemical energy of coal may be utilized, and in a manner so subtile and refined that no visible sign will appear of such an intense action.

Since the discussion of this problem, on the lines given, a most wonderful advance has been made. The features required were an inconsumable electrolyte and oxygen, which would attack carbon without intense heat. Dr. Jacques, of Newton, Mass., has practically followed out the practice outlined so successfully that his results are simply marvellous in comparison with all past efforts. We publish an article in "Modern Progress" which gives some substantial figures, as well as the remarks of Professors Rowland and Cross:

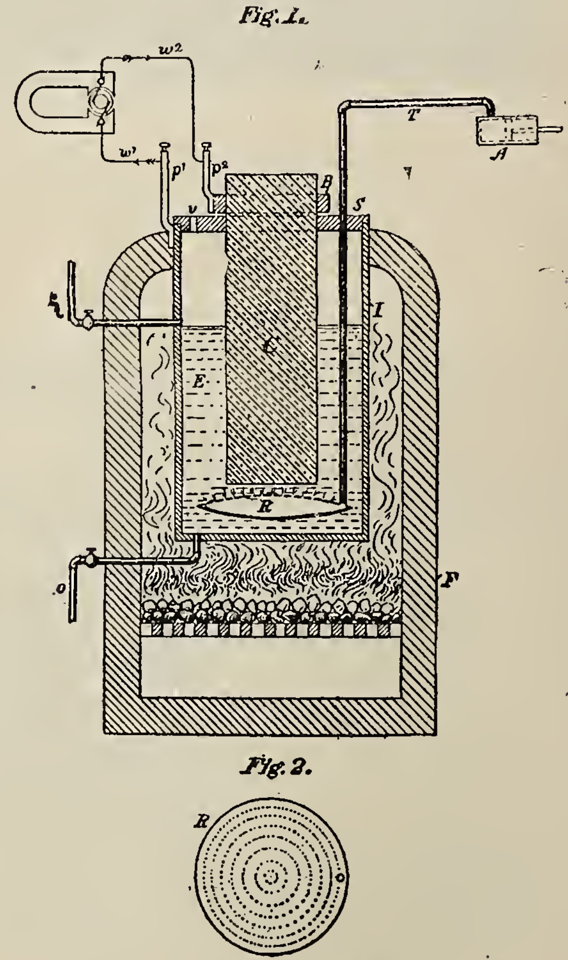
The Jacques' Process of Electrical Generation.—Dr. W. W. Jacques, of Newton, Mass., has recently patented a process by which he generates electricity directly, dispensing entirely with the use of the steam-engine. The innovation has attracted widespread interest, and the "Western Electrician" prints in its last issue additional interesting facts about the process. The interesting features of the process, says that journal, are thus described: "The process consists of converting the potential energy of carbon or carbonaceous material into electrical energy by chemically combining oxygen with the carbon or carbonaceous material through an intervening electrolyte." The problem which this invention claims to have solved, is one that has occupied many brilliant minds. It has been stated by Professor Ostwald that "had we a cell in which electrical energy was produced by the direct oxidation of carbon, with an output approaching the theoretical, we should be on the brink of an industrial revolution, compared with which the invention of the steam engine sinks into insignificance." This is what Dr. Jacques claims to have accomplished, and he is supported in this position by many eminent physicists who have witnessed the results of his experiments and examined his invention.

An idea of the widespread interest that has been awakened in this discovery may be gained from the fact that immediately following the publication of the patent, which was issued on March 3, the Patent Office was besieged with inquiries about the innovation, and demands for copies of the specifications were so numerous that the supply was soon exhausted.

The invention described in the patent was the result of considerable study and research by the inventor. Early in his experiments Dr. Jacques conceived the idea that the oxygen of the air might be made to combine with carbon, not directly, but through the aid of an intervening electrolyte, which should carry it and present it to the carbon. For the electrolyte he selected caustic soda. To carry out this conception he took an iron pot, which became in itself one of the elements of his cell, and into this he put caustic soda, which, at normal temperature, is a solid. Applying heat and raising the mass to the moderate temperature of 300 degrees it fused, giving the desired liquid electrolyte. Into this was plunged a stick of carbon, and an iron tube was then thrust down into the molten mass, almost to the bottom, and through this, by means of a pump, air was forced, which came bubbling up to the surface. But not all of it. The electrolyte caught and held a part long enough to present it to the surface of the carbon, which immediately accepted and combined with the oxygen, which formed a part of the air within its reach. Here, it is claimed, was secured true and perfect oxidization, and with it consumption of but two things, carbon and air. The electrolyte was not attacked chemically. It was not decomposed or deteriorated. It stood ready to perform its function of carrying air to the carbon as long as the supply lasted.

It was found, the carbon and the pot being connected by wire, that a current of considerable volume flowed through it, and that, within limits, the amount of that current was proportioned to the volume of air supplied. It was also shown that the ebullition produced in the mass by the passage of the air through it had the effect of keeping the surface of the carbon free from particles of ash and other impurities, and that it had other advantages as well.

For the construction of this generator Dr. Jacques provided 100 iron pots, each 12 inches deep and 1 1-2 inches in diameter. These were set in 10 rows of 10 each,



DR. JACQUES' BATTERY.

and suspended over a grate, the whole being bricked in to retain the heat. In each of these a suitable amount of caustic soda was put, and this was fused with fire beneath. Then on each a cylinder of carbon was suspended, and the carbon to each pot was connected by a wire with the rim of the next adjoining pot. Wires leading from the first pot and the last carbon constituted the terminals of the generator. Reaching down into each pot was an air tube, and these were all so connected above as to take

the air from a force pump. The terminals being connected through a series of incandescent lamps, current was generated which caused them to glow, the pump being driven by a motor actuated by a small portion of the current.

At this point Dr. Jacques invited Professors Rowland and Cross and Stone and Webster to examine the apparatus and make tests of its efficiency. In his report Professor Rowland said:

"It has long been known that if the oxygen of the air, or free oxygen, could be made to combine with carbon in such a way as to produce electrical energy, instead of heat, an enormous economy would be effected. Dr. Jacques has accomplished this, and I believe he is the first who has done so. Not only is Dr. Jacques the first to my knowledge to show how the oxygen of the air, or free oxygen, may be made to combine with carbon to produce electrical energy, but he is the first to show, so far as I know, any practically operative process by which electricity may be produced through the oxidation of carbon."

Professor Cross, under whose supervision the tests were made, has prepared an extensive report, in the course of which he says:

"When Dr. Jacques first showed me his electrical generator I recognized at once that he had succeeded in offering a continuous development of electricity from oxidation of carbon, such as had previously been sought for in vain by the many persons who had essayed to attain the same results. * * * This is not a process in which there is ordinary combustion, involving a conversion of the potential chemical energy of carbon into heat with an accompanying incidental and slight production of electricity, but one in which the potential energy of the carbon is transformed into electrical energy without the development of heat to any material extent, thus removing it entirely from devices in which ordinary combustion of the carbon and electrolyte takes place."

The tests alluded to were conducted by Stone and Webster, of Boston, under the direction of Professor Cross. Dr. Jacques had operated 30 16-candle incandescent lamps at full brilliancy, and it was desired that the amount of carbon consumed be ascertained and a comparison made with the amount required to do the same work by using present methods. It was found that to maintain these lights for 18 3-4 hours required the consumption in the pots, by oxidation, of about eight pounds of coal. It was also found that the average pressure was 90 volts and that the average amount of current was 16 amperes. It was also determined, by careful measurements and calculations based thereon, that the electrical energy actually obtained from one pound of carbon consumed in the pots was 82 per cent. of the theoretical. In connection with this, it was stated that in large plants, with boiler, engine and dynamo, the average energy obtained from a pound of coal is but six per cent. of the theoretical. In these tests the amount of coal consumed in keeping the electrolyte contained in the pots at the required temperature was not taken into account, the reason given being that "the coal burned on the grate would be much smaller in a generator of larger size." In this connection the report says: "It is, perhaps, fair to say that we may expect the carbon electric generator to yield ten times as much electricity per pound of carbon as does a good average steam engine dynamo plant." In this estimate the fuel burned in the grate is included in the carbon consumed.

The inventor of this process, Dr. William W. Jacques, of Boston, is an electrician and chemist of high standing, who pursued his studies at Johns Hopkins and in Europe, and has been in the employ of the American Bell Telephone Company as its electrician from the beginning. He was peculiarly fitted and equipped for the work of the kind required in developing the carbon electric generator, as he had had long experience in research and experiment.

So important a result on lines parallel with those proclaimed by theory is not surprising. But the simplicity of the method, the cheapness of the material and the readiness with which it was evolved is admirable. It seems as though steam engines are like mile-posts, the faster we fly the quicker we seem to leave them behind; yet they are always in front of us. The steam engine is not yet defunct. Displaced, as it will eventually be, it will still prove an old and tried companion, and until the final and conclusive demonstration is made, it will stand ready with unimpaired vitality to perform the labor of a trusted slave.

(Q.)—PLATING ON GLASS.

Newark, June 23, 1896.

Dear Sir:—In experimenting at home I have often tried to plate on glass without success. If you will kindly let me know in your valuable Inquiry Column how this may be done, I will be under lasting obligations to you. Yours very truly, EDWARD WHITMORE.

(A.)—To plate on glass requires a certain amount of experience and skill. (1) From one authority we quote as follows: Use a concentrated solution of nitrate of silver and gum arabic. After being applied to the glass it is dried over a flame and then electroplated. (2) The second method is to use hydrofluoric acid and etch the glass. The conducting surface is then obtained by rubbing with a ball of fine graphite. (3) The third method is to use a kind of gold paint, and burn it in like the enamel of jewelry.

UNDERGROUND TEMPERATURES.

For several years past I have, with the assistance of Mr. Preston C. F. West, been making rock temperature observations as we increased the depth at which the mining operations of the Calumet and Hecla Mining Company were carried on. We have now attained at our deepest point a vertical depth of 4,712 feet, and have taken temperatures of the rock 105 feet; at the depth of the level of Lake Superior, 655 feet; at that of the level of the sea, 1,257 feet; at that of the deepest part of Lake Superior, 1,663 feet; and at four additional stations, each respectively 550, 550, 561 and 1,256 feet below the preceding one, the deepest point at which temperatures have been taken being 4,580 feet. We propose when we have reached our final depth, 4,900 feet, to take an additional rock temperature, and to then publish in full the details of our observations. In the meantime it may be interesting to give the results as they stand. The highest rock temperature obtained at the depth of 4,580 feet was 79° F.; the rock temperature at the depth of 105 feet was 59° F. Taking that as the depth unaffected by local temperature variations, we have a column of 4,475 feet of rock with a difference of temperature of 20° F., or an average increase of one degree for every 223.7 feet. This is very different from any recorded observations, Lord Kelvin, if I am not mistaken, giving as the increase for one degree F., fifty-one feet, while the observations based on the temperature observations of the St. Gothard Tunnel gave an increase of one degree for sixty feet. The calculations based upon the latter observations gave an approximate thickness of the crust of the earth in one case of about twenty miles; in the other, twenty-six. Taking our observations, the crust would be over eighty miles, and the thickness of the crust at the critical temperature of water would be over thirty-one miles, instead of about seven and 8.5 miles as by other and older ratios. . . . The holes in which we placed slow registering Negretti and Zambra thermometers were drilled, slightly inclined upward, to a depth of ten feet from the face of the rock and plugged with wood and clay. In these holes the thermometers were left from one to three months. The average annual temperature of the air is 48° F.; the temperature of the air at the bottom of the shaft was 72° F.—Prof. A. Agassis in *American Journal of Science.*

BERGEN, N. Y.—A project is on foot to connect Bergen with adjoining towns by telephone.

RESULTS ACCOMPLISHED IN DISTRIBUTION OF LIGHT AND POWER BY ALTERNATING CURRENTS.

(Concluded from page 362.)

W. L. R. EMMET.

FIGURE 6 shows diagrammatically the distribution of voltage with a given balanced load on a two-phase, four-wire circuit, and on the same circuit with one wire discarded, the third being used as a common return for the two sides of the system. S F and E G represent the two generated voltages on the four-wire, two-phase system. F F′ and G G′ represent the electromotive forces of self-induction in the lines of the separate two-wire branches of the circuit. F′ F″, G′ G″ represent the resistance drop in the two branches. E F″ and E G″, which are still at right angles, represent the two voltages at the end of the line.

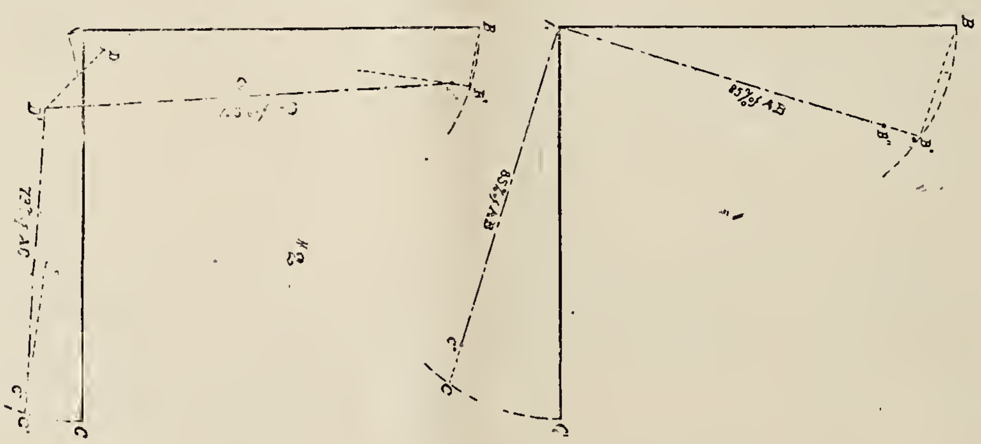
The other diagram in Figure 6 shows the condition on the three-wire circuit. A B and A C represent the generated voltages in quadrature. C C′ and B B′ represent the volts of self-induction in the outside conductors. C′ C″ and B′ B″ represent the volt's drop by resistance in these wires. A D is the resistance drop in the third wire and D D′ is the electromotive force of self-induction in the third wire. Since this wire carries forty per cent more current than the others, A D is forty-two per cent greater than C′ C″, and B′ B″ and D D′ bear the same proportion to C C′ and B B′. The lengths of D′ B″ and D′ C″ represent the voltages on the two sides of the system at the end of the line. The angle C′ D′ B″ is the phase relation of these two circuits and is less than 90 degrees. Thus with balanced load the sides of the system are neither equal or in quadrature.

The figures are so proportioned as to represent a circuit of "OO" B. & S. wire, operated at 125 cycles with ten per cent resistance drop on the four-wire system, and the same load and the same distance with three wires. With 1,000 volts at the generator in both of these cases, we would have 850 volts on each side with the four-wire system, and with the three-wire system 730 volts on one side and 1,030 on the other. This assumes aerial lines with ordinary spacing of wires. In addition to the systems above described for distributing power by induction motors, we have other means of power distribution by alternating currents. The synchronous motor, for certain classes of work, is highly efficient and reliable, and is extensively used, although it will not fill all the requirements of general power distribution. The rotary converter also fills a very important place in the engineering work of the day.

A synchronous motor is simply an alternating dynamo whose functions are reversed. They may be used either on single phase or polyphase circuits. In its simple form a synchronous motor has no power of starting itself on a single phase circuit. On a polyphase circuit it starts with more or less tongue as an induction motor, and will come to synchronism. As a rule, however, the starting of synchronous motors is not vigorous, and is accomplished by a large draught of current; hence their applications are limited.

A rotary converter is a synchronous motor of suitable construction, whose armature windings, besides being connected to collector rings, are also connected to a commutator. As the machine revolves at synchronous speed brushes collect direct current from the commutator, this current being partly rectified and partly generated by the machine. This machine deals in direct and alternating currents and mechanical power; supply it with any one of the three, it will deliver either one or both of the others. It is most efficient when filling its functions as a converter from alternating to direct currents. Its capacity is then greater and its efficiency higher than when it runs as a generator or as a motor.

To illustrate the use of the rotary converter, I will describe an application now under consideration. The company in question is operating three stations; one of these is very large and centrally situated, with condensing water and every facility for the cheap generation of current. Each of the other stations is about two miles from the main station; both work non-condensing. One of these stations delivers current only on the direct-current, three-wire system, while the other, in addition to similar work, carries a considerable arc light load. In this case the following plan is considered:



At the two smaller stations rotary converters would be installed, and would deliver only direct current in one case, while in the other they would also act as motors to operate arc machines through a countershaft, to which they would be belted with clutch pulleys. Suitable step-down transformers would connect the rotary converters to a high-tension line leading to the main station. At the same station three-phase generators of large capacity would be installed. These generators would be designed to deliver both three-phase alternating currents to step-up transformers, and also direct currents at about 250 volts to the outside conductors of the three-wire system. They would be directly coupled to engines. These machines would deliver current simultaneously, in any proportion, to the direct-current, three-wire system, to the rotary converter, or to lines distributing three-phase power.

It is proposed to operate these machines at a frequency of twenty-five cycles per second, this being well adapted to the direct-current work and also to three-phase power distribution.

In this plant an entirely independent control of direct-current pressure within a wide range would be necessary at the main and sub-stations. This would be effected without the introduction of idle currents, by the use of a novel form of three-phase induction regulator connected to the alternating leads of each rotary converter. These regulators would give a wide range of adjustment without any moving connections, and would greatly simplify the operation of the plant, and also increase its economy, since the losses introduced by the regulators themselves are very small, and since conditions of general

economy are always maintained. Thus a single engine could carry the whole load of the city at certain times.

Another interesting illustration of a combination of alternating and direct currents is found in a case now under consideration. A company controls about 3,000 horse-power in water at a distance of eleven miles from a large town. It is proposed to install three-phase, sixty-cycle generators in 600-kilowatt units. The current from these generators will be transformed to 10,000 volts and carried over three wires to a city sub-station centrally placed. Here large step-down transformers will be installed, delivering current to 2,000-volt lines, which extend all over the city and carry motors and lights in outlying parts.

In the same station two large Corliss engines are now in operation, and are belted to clutch pulleys on a countershaft, which operates some arc machines and other load. To this same countershaft it is proposed to couple with a clutch a large synchronous motor which will be connected to the 2,000-volt lines. When the water supply is ample, the engines will be shut down and the motor will run the shaft. When the water is low, or more power is required, the engines will be run and the synchronous motor will then act as a generator, running in parallel with the transmission line.

In the central part of the town it is proposed to install a system of three-wire mains and a large storage battery. This battery would be installed in a second sub-station, conveniently placed. It would be charged from a pair of direct-current machines, directly coupled to a synchronous motor operating from the 2,000-volt lines. The direct-current machines would be used in connection with the batteries for supplying the three-wire system. The plan here outlined has many very positive advantages.

The pressure on the 2,000-volt system can, within certain limits, be controlled at the sub-station by adjustments of the field of the synchronous motor. With telephone communication to the power house, the control will be perfectly easy. The peak of the lighting load being borne by the battery, the generators can be loaded nearly to their full capacity with motors during the day. At night they will charge batteries, using water which would otherwise run to waste.

A Wonderful Machine.

Professor Langley's remarkable instrument known as the bolometer, occupying the entire building of the astro-physical observatory attached to the Smithsonian Institution, is pronounced by Rene Bache the most delicate mechanical contrivance ever devised, inasmuch as its "senses" are more acute than those of any human being. Outside of the building a huge machine, the inside works of which are a clock-work mechanism, pumps sunshine through a long tube into a dark room, where the bright ray passes through a prism; the latter is not of glass, because glass is opaque to the invisible rays of the solar spectrum, but is of rock salt, carefully cut to a certain angle by the famous optician Brashear, and, though the prism looks almost opaque to the eye, it is as crystal to the invisible rays above the violet and below the red. Thus the operator is able to follow the invisible rays along their dark path, their presence and potency being accurately registered, having for its most essential part a balance composed of a thread of spun glass and a tiny mirror, the latter attached to a piece of a dragon fly's wing.—Industrial World.

Aluminum Preserver.

What is claimed to be a remedy for one of the principal obstacles to the general use of aluminum, to wit, the oxidizing of the surface, has been discovered by Professor Gotting, of the Berlin Artillery and Engineering Academy. The aluminum is dipped into a diluted solution of certain salts, not made public, which turn the surface into a brown substance of great resisting power, resembling Japanese bronze. Experiments are being made to find out whether it can be used for cooking implements for the German army.—London Invention.

ROENTGEN RAYS.

An Eclipse.—"One seems in a new world—a world filled with awful sights and strange forebodings, and in which stillness and sadness reign supreme; the voice of man and the cries of animals are hushed; the clouds are full of threatenings and put on unearthly hues; dusky, livid, or purple, or yellowish crimson tones chase each other over the sky irrespective of the clouds. The very sea is responsive and turns a lurid red. All at once the moon's shadow comes sweeping over air and earth and sky with frightful speed. Men look at each other and behold, as it were, corpses, and the sun's light is lost."—*Mr. Lockyer.*

Transparent Mirrors.—It appears at first sight to be a contradiction in terms to speak of a transparent mirror; but in these last days, science has been able to achieve that incongruous combination. One of the best known methods is that of Kundt, who painted a piece of glass with a platinizing solution (which is now in the market), and then heated the glass in a furnace till the platinum fused into the surface of the glass. A sheet of glass treated in this way acts as a mirror when the strongest light is on the same side of the glass as the observer, but will appear transparent when the strongest light is on the opposite side from the observer. The following is another method of producing a transparent mirror, which has been patented in Germany, but for which we cannot otherwise vouch: Dissolve one part by weight of silver nitrate in 10 parts by weight of water, and label No. 1. Prepare another 10 per cent. solution of silver nitrate, but in larger quantity; to this add ammonia water, drop by drop, stirring carefully until the precipitate formed at first is completely dissolved, and label No. 2. Now add solution No. 1 to solution No. 2 until the odor of ammonia is no longer recognizable and the liquid has again become very turbid. Now add 100 parts by weight of distilled water for every part of silver nitrate originally used in solution No. 2, and filter until clear. Label this No. 3. Prepare a reducing solution by dissolving 0 8 part by weight of Rochelle salt in 384 parts by weight of distilled water; boil, and to the boiling solution add gradually a solution of three parts of silver nitrate in 10 parts by weight of distilled water and filter when cool, and label No. 4. Clean the glass to be coated thoroughly; lay it on a perfectly level surface in a room at a temperature of about 25° C. (77° F.). Mix equal parts of No 3 (the depositing fluid) and No. 4 (the reducing fluid), and pour over the glass. The glass may, if preferred, be dipped into the solution. The time required for the deposition of the layer of silver of just the correct thickness has to be determined by the judgment of the operator in each case, and this may be aided somewhat by observing a piece of white paper below the plate of glass. When a sufficient deposit of silver has been made, and much less is required than for an ordinary mirror, pour off the silvering liquid and rinse thoroughly with the distilled water, and stand the mirror on edge to dry; coat the silvered side with a solution of colorless shellac in alcohol, and finally frame the mirror with a backing of clear glass to protect the mirror surface from being scratched.—*Electrical Review.*

Killing Whales by Electricity. It appears that electricity is now to be used for the purpose of killing whales. A dynamo with power-producing apparatus is to be placed on a whaler, and not used until the whaling grounds are reached. On board there is to be placed a big reel of insulated wire, which is to be placed in a boat when a whale is sighted. One end of the wire is connected with the dynamo, and at the other end, which will be in the boat, will be a hard rubber stick, and attached to a piece of metal 24 inches long and one inch in diameter. This metal rod is sharp at the end, so as to penetrate the flesh of the whale easily. The combined rubber and metal rods will be used just as a harpoon is now used, and when near the big fish the harpooner will throw the electric barb. At the time of striking there will be a current of 10,000 volts running through the wire. When the point of the needle strikes the whale, a current connection will be formed with

the dynamo, the whale will get the full shock of the high voltage, and will be dead in the fraction of a second. At least, this is the calculation of the enterprising captain of the whaler.—*Industrial World.*

FRANKLIN LEONARD POPE.

IN MEMORIAM.

(Continued from page 368.)

This compliment from Mr. Pope's native State is one that was creditable alike to both parties. Mr. Pope arrived in San Francisco on the 27th of April, 1865, and shortly after proceeded to New Westminster, whence he started, in June, northward upon his perilous undertaking. From New Westminster to Quesnel, about 390 miles, north upon the Fraser River, the route was considered as a comparatively easy one for the construction of the line, and work had already been started upon this section by Assistant Engineer Edward Conway, the first pole being set on February 24th. The nature of this part of the country may be gleaned from a letter written at the time by Mr. Pope, who says: "The Colonial Government is now engaged in cutting a road from New Westminster to Yale, a distance of 90 miles, along which the wire will be carried. There has heretofore been no communication between these two points whatever. The river (Fraser) is bordered on both sides by high mountains and dense forests of heavy timber with an almost impenetrable undergrowth.

"Notwithstanding these difficulties, Mr. Conway, during the last part of last winter, made an exploration of the entire route upon snow-shoes, a feat never before attempted by any white man."

Mr. Pope also says: "It will be a matter of considerable difficulty to construct a line of telegraph over that portion of this road which passes through the 'Great Cañon,' as in many places the road has a perpendicular wall of rock upon one side, and a perpendicular precipice on the other, and in one place is carried around the face of a cliff in this manner at an elevation of some 2,000 feet directly over the river, being in some parts blasted out of solid rock and in others supported by a sort of staging."

There is nothing in this description of the first step in the enterprise calculated to reassure or cheer the hardy explorer who was bound northward into an Arctic country that was an absolute terra incognita, even to the adventurous fur trader of the Hudson Bay Company. This rugged, mountainous, volcano-torn and tossed rock-ribbed wilderness, presented tremendous impediments to exploration, which involved weary months of climbing over towering rocks and mountain ridges, precipices, through swamps, fording cold and dangerous streams—ever and anon scrambling over ragged promontories of river banks or skirting their bases with but slender foothold, amidst the defile of lofty mountains clad in perpetual snow. Such physical difficulties demanded a courage and endurance that but few men possess. Oft-repeated attempts would be made to find a passage over the mountains, but impassable barriers would as often turn back the explorers. A practical path at times seemed to be opened up by a defile, but only to terminate in a chaotic and impenetrable mass of cliffs and boulders, causing many painful retreats amidst the Arctic cold and snow, many times with scant food and no shelter. It was under such conditions that Mr. Pope carried on his explorations from June, 1865, to May, 1866. He succeeded in surveying the route as far north as the head-waters of the Stikeen River, which are about 1,100 miles from New Westminster, and 200 miles from the Pacific Ocean. Arriving there in the middle of April, it was found necessary to stop explorations until the following winter on account of the approaching mild season, the snow being necessary to enable the explorer to travel over dense underbrush and other obstacles so graphically described by Mr. Pope in a private letter written from Lake Tatla, B. C., Nov. 7, 1865, as follows:

"I have just returned from an exploring expedition north to Fort Connolly, about 60 miles from here. We had to carry our blankets, provisions, axes, frying-pans, guns and forty other traps on our backs, and the whole forest from here to there has been burnt, and has all blown down, and the logs are piled up 'criss-cross' in every direction several feet high, like a pile of matches thrown on the floor. It was nice work climbing over that pile of stuff for over 60 miles with the load we had. Then we had to wade a river, nearly twice as large as the Housatonic, about daylight one morning, with the ice running down. To add to the beauties of the situation, we got snowed up in the mountains, and had to stay there until all our 'grub' was eaten up, and when we finally got out, had to travel all the way back again with nothing for three of us to eat, except two dried wood-chucks and four dried fish. We used to scramble over the logs all day and sit down at night and eat our pieces of dried wood-chuck, about as large as a plug of tobacco and a good deal tougher than gutta-percha, with first rate appetites."

In another letter, dated New Westminster, June 15, 1866, Mr. Pope gves us a sample of his power of description, as well as an insight into the trying task he had set out to accomplish after he left Lake Tatla to reach the head-waters of the Stikeen, as well as his adventurous trip down that river to the ocean, on his way to New Westminster, to perfect plans and arrange for supplies to resume explorations in the wilderness northward between the Stikeen and the Yukon Rivers. He says:

"The little party was composed of two white men, Mr. George Blenkinsop, of Victoria, and myself, with two Indians to assist in cutting firewood and carrying the provisions. We were furthermore provided with a sledge and team of four dogs, which, when we set out, carried four hundred pounds of provisions and other necessary articles. Each of us was also furnished with a pair of snow-shoes, without which one could not move ten rods from home in the deep snows of this northern climate. Thus equipped we set out on our journey into the unknown wilderness, with no guide but the compass, and the certainty that the River Stikeen lay at an unknown distance to the northwest. Our greatest difficulty was caused by the depth, and more especially the lightness of the snow, in which the dogs would sometimes struggle for an entire day, with merely their heads above the surface, we drawing the load ourselves, and sometmes even carrying the dogs on our backs, when they were too much exhausted to move. For many days we thus laboriously worked our way up the valley of the Skeena, making an advance of only three or four miles per day with the utmost labor and difficulty. The snow in many parts of this valley was ten feet in depth.

"On the 23d of March we reached the head of Skeena River in a beautiful prairie about fifteen miles in length and surrounded by lofty, snow-clad mountains. Here we were obliged to kill one of the dogs which was worn out with the severe labor, and unable to keep up with us. Matters thus far had been anything but encouraging. After a month of protracted and very exhausting labor we had accomplished but 150 miles, and our dogs were nearly all 'used up,' and in a fair way to soon follow the first one killed, which would leave us without any means of transportation for our provisions in the heart of an interminable wilderness. We two, excluding the Indians, who, of course, wanted to return, held a council of war, at which it was unanimously decided to 'go ahead.' So we pushed forward, and from that moment circumstances favored our enterprise. The snow became firm under our feet, and the three dogs trotted along merrily with the load over its smooth, hard surface. We were now following a stream which I knew from the nature of the country must be a tributary of the Stikeen, and, indeed, it was the identical river itself

(*To be Continued.*)

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CONTENTS.

	PAGE
EDITORIALS	
A Horse-Power in a Watc-hCase	379
Rail Bonds	379
Today	379
GENERAL SUBJECTS	
Electricity Direct from Coal	373
Underground Temperatures	375
Results Accomplished in Distribution of Light and Power by Alternating Currents	376
Franklin Leonard Pope	378
Testing of Circuits	380
Test of Rail Bonds	381
Artificial Daylight	382
Evolution of Interior Conduits from the Electrical Standpoint	384
American Street Railway Convention of St. Louis	385
EXTRACTS	
Roentgen Rays	377
TRADE NOTES	
Stiles and Fladd Press Co.	386
Mianus Electric Co	387
New Corporations	387
Possible Contracts	387
New Telephone Companies	387
New York Notes	387
PATENTS	388
Telephone Patents	387

A HORSE-POWER IN A WATCH CASE.

A well-known daily journal, after having expressed its opinion in an interesting manner on the present position of applied science in the commercial world, concluded by saying that all progress could be summed up in the word "economy." With but slight variations, this is true. The use of power, or at least its generation, is attended at all times with great loss. A pound of coal contains many units of heat. We are put to the trouble of extracting some of this power and then of transforming it by means of engine or motor into systematic motion.

The reduction in power met with on every side as the transformation or transmission continues is very heavy. A steam engine having the most improved parts, and a standard boiler, is able to use only a small fraction of the original energy of the coal. Out of every hundred pounds burnt, about ten are used in the average case and fourteen in the most perfect engines known. It is, therefore, true that progress in the field of applied science is based upon the true meaning of the word, economy. It not only governs the inorganic—the wide fields opened up by inventive genius—but the organic as well; nay, even in a more striking and visible sense.

The recent invention of Dr. Jacques is of a unique and surprising character. It is unique because new, and surprising on account of the readiness with which it was produced. Many years ago the use of coal for the purpose of heat was considered wonderful; since then an evolution has taken place. Wastefulness is almost considered a crime. The burning of coal is, with all its simplicity, a crude and primitive way of obtaining power.

Coal can be consumed by means of oxygen without heat, if the oxygen be insidiously introduced. The avidity with which carbon feeds upon it is remarkable. A substance which throws this controlling net over the intense chemical changes that would otherwise ensue is caustic potash. An iron pot filled with this cheap alkali, a stick of carbon and a pipe to blow air through, completes the apparatus. An estimated efficiency of over 80 per cent. has placed this far above the best attempts of the past. While the report that a $5,000,000 corporation has been formed dignifies this invention, we will not appraise it any higher than the least, until its value has been practically demonstrated for either station or home.

RAIL BONDS.

The bonding of street railway tracks has become a painful experience to engineers. So far their attempts to successfully bond the rails have been like the efforts of Sisyphus. Heroic measures have been adopted to overcome the defects arising from imperfect joints. Rails have been joined by heavy castings and in several cases completely welded together. The number of bonds that have been used for merely trial experiments are countless. There is not in use to-day one reliable bond which will wear well and not cause an unearthly drop with a heavy current. A partially welded bond is good because it means an excellent mechanical job and a tight electrical joint. There is a bank account waiting for somebody that will stir his inner consciousness successfully on the rail-bond question.

TODAY.

In many of the great questions of popular interest we are forbidden discussion. But if these matters are of such importance that they affect all industrial circles alike, it is time the silence was broken, and the voice raised in condemnation or appeal. The inevitable changes going on are irresistible. In their glacier-like progress men and reasons are crushed. A great political question to-day is like the car of the juggernaut, none can stand in its way with impunity. Those that ride it see victims strewn on every side.

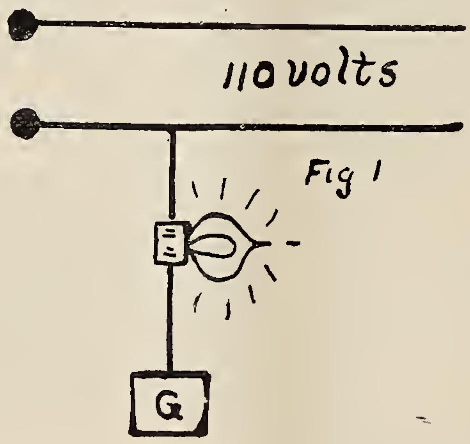
There are divisions in state, splits in party, and breaks in organization to an extent hitherto unequalled. The deep, strong voice of political enmity has become fierce with denunciation. The East does not know the West and the North threatens the South. On all sides the clamor has increased. Men of strong purpose are caught in the torrent and drift they know not where. Each party firm in its convictions, selfishly confident of victory; their opinions the outgrowth of local environment, and their attitudes threatening in the extreme. We are face to face with three propositions: Gold, silver or bimetallism. The supporters of each predict destruction for the other. A long period of peace or of frightful calamity is bound up in each. We say the most precious metal must be the standard. Industry will then revive, the iron-bound chests will open wide, and money, the life blood of trade, will circulate with healthy pulsation.

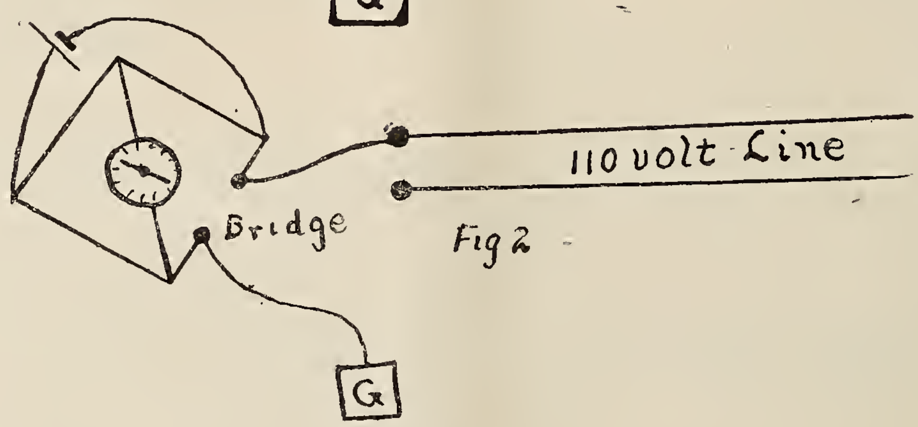
TESTING OF CIRCUITS.

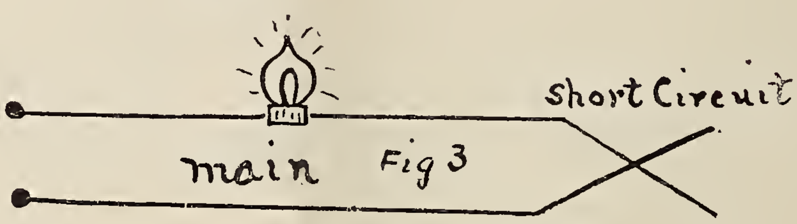
LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

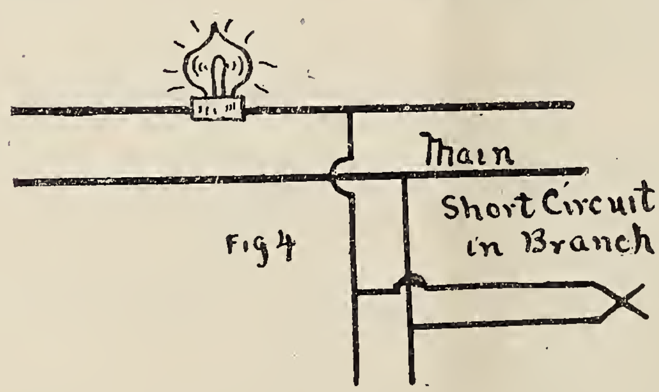
BY NEWTON HARRISON, E. E.

A house that has been wired and connected to the street circuit is likely to blow out fuses or remain unlit in certain portions, unless a thorough test is made to expose such faults and to remedy them. The troubles which most likely exist, as well in lighting crcuits as in other electrical outfits, are grounds and short circuits.









Short Circuits.—Under these two headings, each with all its variations, may be examined and located.

The presence of a short circuit is due to the fact that two wires of opposite polarity have come into metallic contact. This may occur in the main line as well as the offshoots, or local circuits. Its presence is denoted by

(a) Absence of light.
(b) Blowing of fuses.

The danger of a short circuit is always present, becausd two wires may touch in a socket, cross in a line, or come, by a combination of circumstances, in connection with another piece of metal.

All of these constitute a short circuit, but the danger due to each is less and less the smaller the wire. The likelihood of melted metal dropping upon combustible material, or fire from heated vapor, is the greatest source of danger.

Test.—To make a test for a short circuit, it may be at once understood that if this trouble exists in the main line the current can never reach the feeders or branches. To make a test, place a lamp in between one leg of the line and one leg of the street circuit from which the other has just been disconnected. Have everything else in the house turned off and the lamp will not burn if the line is free. If a short circuit exists, the lamp will burn brightly.

Location of Short Circuit.—The short circuit may be either in the main line, feeders or branches.

Test of Main Line.—Is made by taking out all the fuses connecting the main line with the feeders. If the lamp goes out, the feeders or branches contain the short circuit, and the main line is free.

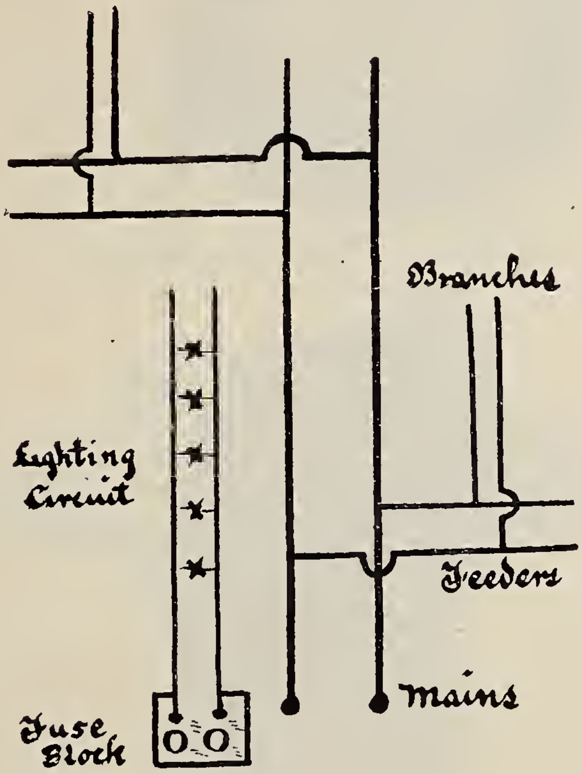
Test of Feeders.—The feeders are tested one after the other, in the same way, but the fuses connecting them with the branches are taken out. If the feeders are free, the insertion of fuses between them and the main line will not light the lamp.

Testing of Branches—The branches are now connected one by one to the feeders by screwing in Edison plugs or using link fuses. The lamp will not light up unless one is short circuited, and then only when that one is connected to the feeder. By this systematic practice, the test may proceed, step by step, from line to feeder and to branch circuit. The method employed consists, first, in the dis-

covery of trouble, and, secondly, in its location. This principle is followed out in the location of another great and distressing trouble called "a ground."

Testing for a Ground.—A ground may be considered from two standpoints, whether it is a dead ground or partial ground, and treated accordingly.

The general test of a house may include everything at first. It may be made with a lamp for the determination of its locality, as follows: A lamp is connected to a gas pipe and to a leg of the main line; provided a three-



wire system is not being used, the test will show whether the line is dead grounded or not.

The lamp will glow brightly if the ground is dead, and unless it is a partial ground of very high resistance, the lamp will have a reddish heat to its filament. Should the line be a three-wire system, this test would always show up with the lamp bright because the middle wire, called technically the "neutral" wire, is grounded, and between any grounded object and either of the outer wires the full lamp pressure exists. The test which will be good for either two or three-wire systems is made with a Wheatstone bridge.

Test with a Bridge.—The use of a bridge in connection with a thorough test is quite essential. It is also simple and reasonable to make. The fuses of the feeders which connect them to the main line are removed; the connections with the street service also. The main line is now isolated from the rest and any trouble discovered resides in it alone. One leg of the line is connected to the bridge and a gas pipe is also connected to it.

A test for insulation will now be made between the wire and the earth. If a partial ground exists it will be indicated, and may range from 1,000 to 100,000 ohms resistance; should the test show from one to three million ohms, the leg is practically perfect. The other leg is tested in the same manner, the gas pipe connection being preserved as before. Each wire may be put through the same process if a perfect test is desired. A circuit may be tested, one leg alone being tried, if the wiring work has been carefully done. Care must always be taken with such work to see that the lighting current is off or the bridge will be ruined.

The general test, with all fuses in, will at once indicate the presence or absence of a ground of any extent.

Moist plaster is injurious in its effects upon the insulation of a house. The quality of covering used for the wire, even though of first quality, if enough is used, will pull down the insulation resistance more and more.

If 100 feet of wire have an insulation resistance of 1,000,000 ohms (1 megohm) 50 feet of the same wire would have an insulation resistance of two megohms. This fact at once shows the influence of a great mass of wire upon the total insulation resistance of a house.

Some other difficulties in the way of wiring contractors is the troubles arising from poor connections at cut-outs, badly soldered joints and loosely put up wires.

Bad joints are productive of heat and cause drop in the line. A loose joint has been known to set fire to a house.

Poor connections are one of the same family, and make their appearance known by bad light in the lamps. A cut-out will occasionally get so warm on account of this that the spreading heat will melt or help to melt the fuses. When a house is free from short circuits and grounds, it is practically ready for current.

The lamps will burn at full candle-power if the drop has been kept at its lowest point, and the house is otherwise satisfactory by test.

TEST OF RAIL BONDS.

In the Synopsis of Electric Power, the compiler, Mr. Osterberg, has reproduced a very interesting test, which is given below. The information contained in the columns of this report is excellent. It is not only excellent, but useful. If some one had only been kind enough to bury the rails for six months and then renew the test a long story would have been cut short.

Copper bonds are now being used by the Brooklyn City Traction Company, but they are partially welded on. This bond occupies more of the time of unhappy corporations than the marital bond does the city courts. The deterioration of all bonds at the present time has made the trolley companies hustle to get a new one that will survive the wear and tear of practice. There is quite a field here for a wideawake engineer to make some money. Before beginning, study the test.

The following resistance test of rail bonds was recently made at the power house of the Buffalo Railway Company, and the results will be of much interest to railway engineers:

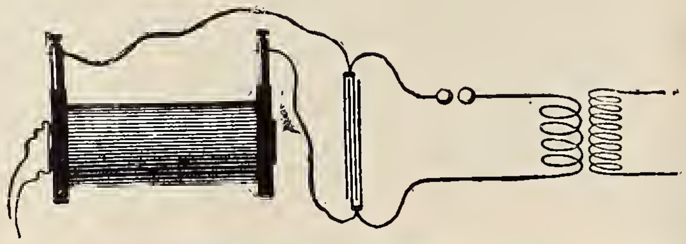
Type of Bond.	Size of Girder Rails used. Lbs. per yard.	Current in Amperes.	Drop in Bond Volts.	Condition of Bond at end of Test.	Remarks.
Copper............	90	125 1,200 1,450	0.0375 0,208 0.313	Very hot.	With one No. 00 bond 6 inches long through rail base, contacts clean, tight and new.
Copper..	90	200 1,200 1,500	0.028 0.178 0.21		With one No. 0 copper wire 30 inches long, newly fastened with channel pins.
Plastic Bonds.....	90	160 200 1,200 1,400	0 002 0.01 0.035 0.04	Cold.	With standard type of plastic bond between web of rail, and angle plate on one side only.
Plastic Plug Bond.	62½	190 400 1,200 1,500	0.00436 0.0201 0.0628 0.086	Cold.	Rails on chairs with T rail under joint; one pair of ⅝-inch holes through chair, and rail base into top of T rail; holes amalgamated and filled with plastic alloy.
Plastic Plug Bond.	62½	190 1.200 1,300	0.00186 0.0428 0.0422	Cold.	Ditto, with one pair ⅝-inch holes on each side of rail; amalgamated and filled with plastic alloy.
Plastic Plug Bond.	62½	200 1,000 1,300 1,500	0.0026 0 038 0 0554 0.067	Cold.	With horizontal hole, ⅞-inch diameter in meeting ends of rails, with grooved steel dowel pins; amalgamated and filled with plastic alloy.

Compiled from *Elec. Railway Gazette* in *London Electrician*, March 20, 1896.—*Electric Power*.

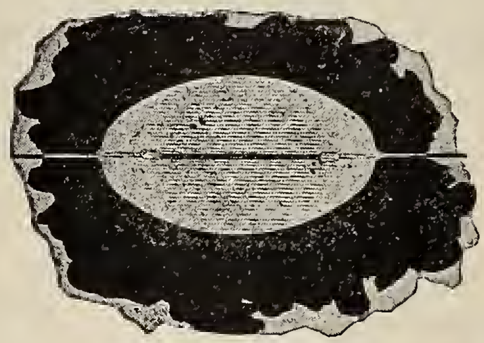
An infinite variety of conditions exists in different cities, and the question of electrical distribution must be carefully studied in each case, in order that money may be invested to the best advantage. An intimate knowledge both of the apparatus available and of the commercial conditions is necessary to an intelligent decision in such cases. It is only through the exercise of intelligence and judgment of a high order that the best results can be obtained.

ARTIFICIAL DAY-LIGHT.

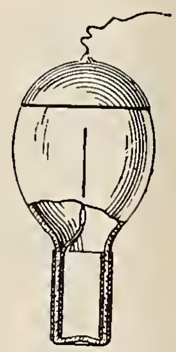
When the shadow of night has killed the waning twilight, both man and beast alike feel a sense of insecurity, a distrust of their surroundings, an instinctive fear of solitude in the sombre darkness.



Manner of Operating an Induction Coil.

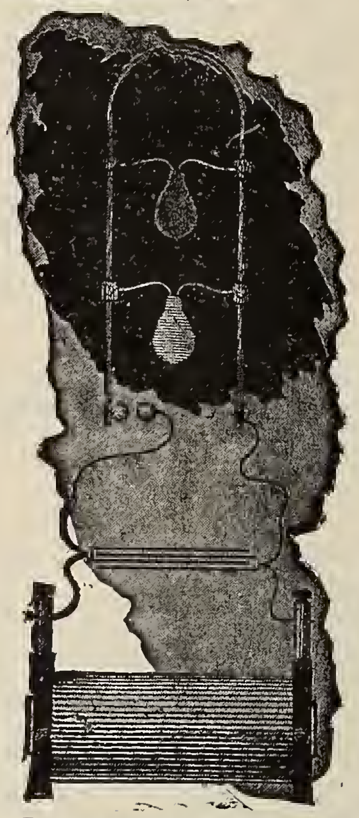


Phenomenon of Impedance in an Incandescent Lamp.

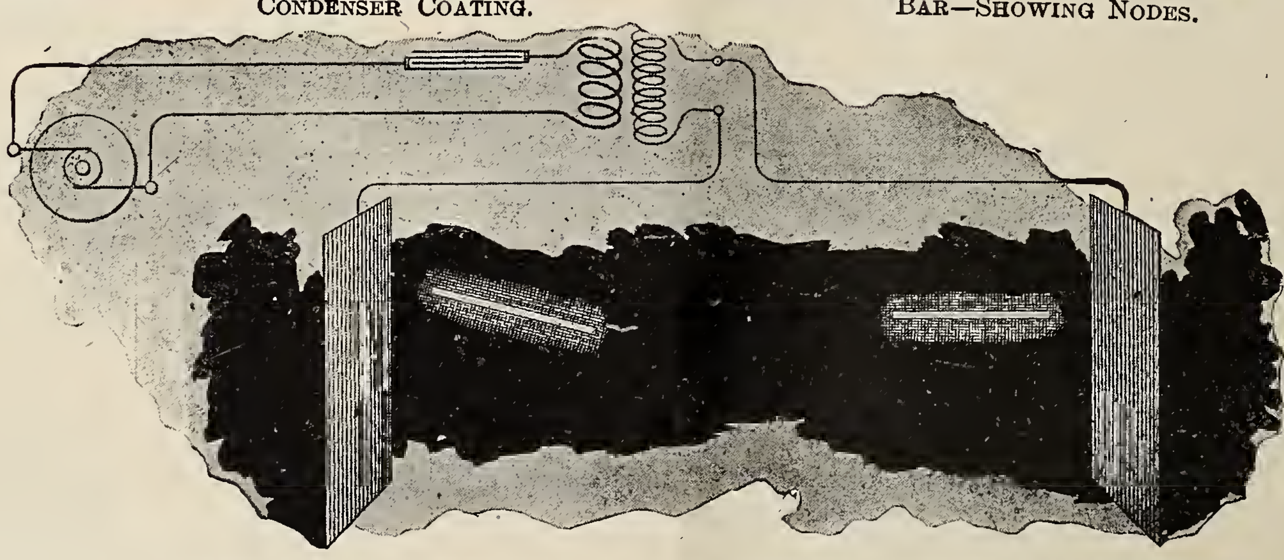


Lamp with One Filament, One Inside and One Outside Condenser Coating, and Auxiliary Coating.

Lamp with One Filament, One Inside and One Outside Condenser Coating.



Lamp Kept at Incandescence across a Thick Copper Bar—Showing Nodes.



Ideal Method of Lighting a Room.—Tubes Devoid of Any Electrodes Rendered Brilliant in an Alternating Electrostatic Field.

This is the age of light. More inventions for the production of better light have been made in the last twenty years than in the entire past history of the world.

Light is essential to our happiness. There is no means known of determining with any degree of accuracy when the first ray of light pierced the depths of space. The uncountable systems of planets stretching far out beyond imaginable limits, looking like faint blurs in the sky, have poured their light unceasingly upon this and myriads of other worlds from time immemorial. It is, therefore, fair to assume that with the existence of energy and matter we find light. In the most mysterious of nature's moves light is to be seen; from the vast streaming mass of nebulous world-matter, to the incandescent brightness of a fiery planet. All the stages of growth are marked by degrees of luminosity; and in the final scene, when the signs of a universal desolation have appeared, the reflected light still shows the whirling planet, a charnel house of civilization, a sterile tract, dead like the bare and arid surface of the moon. It is not the greater phenomenon alone which must receive attention; they may be used as a standard of comparison, a means by which to gauge the value of a new light, and thus to form an estimate of its fitness to be called artificial daylight. A

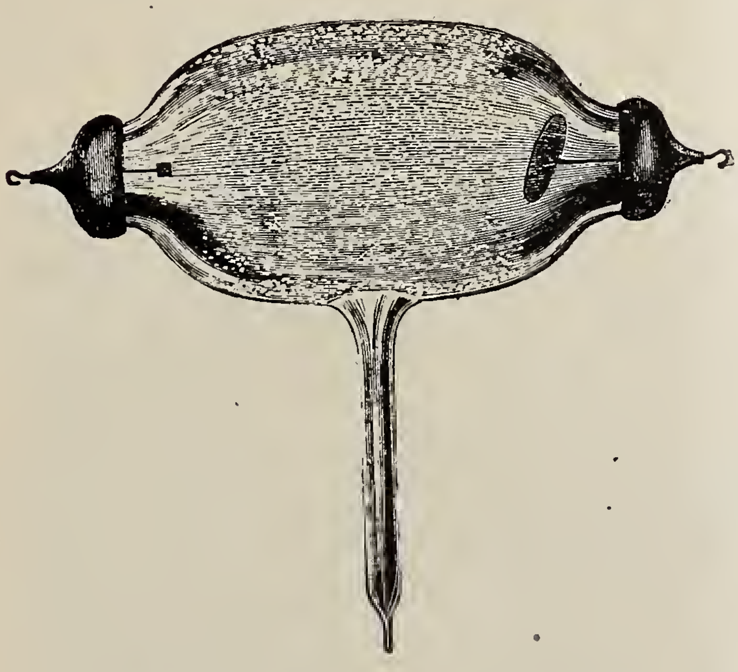
change in the distribution of the planets might have lifted this earth forever into perpetual light. The social and physical effect of such a change cannot be commented upon here. In the new era of artificial daylight, the present wasteful methods will be replaced by those of highest efficiency, and, perhaps, the city will bathe at night, as in the day, in the brilliant luminescence of an artificial sunshine.

. . . .

The direction of modern progress has been strongly marked in the last few years. The means of artificial illumination are comparatively few to-day. Light from candles, oil, gas or electricity comprise the four. In all departures from any specific line the same startling loss appears and shows with striking significance the uselessness of pursuing old practices.

Candles are like oil in this respect; primitive and practically incapable of competing further with the improved appliances for the use of gas and electricity.

The field is thus left to two mighty opponents, whose



EDISON'S FLUORESCING VACUUM LAMP.

grasp on the civilized world is individually so great that it is doubtful whether one is to be found without the other. It seems, therefore, that gas and electricity will each retain a certain position; their strength and weakness being solely determined by the circumstances that govern each case.

It is predictable, however, that the final outcome of so severe a state of competition will be the complete exclusion of gas in many cases as a source of both light and heat. Gas to-day is cheaper than electricity, but the next move that is made will bring the cost of light at least to so low a point that although as power the cost of gas may lie in abeyance, not the least doubt will remain of its inferiority as a source of light.

Gas has obtained an excellent position in the eyes of consumers, due to the use of Welsbach burners.

The light obtained by means of gas in common with that produced by an incandescent filament is inefficient to a great degree. Energy must be supplied to heat a quantity of material before light can be produced; it must be continually supplied or the light will cease; where we require but one form of energy we have two; great quantities of heat are therefore wasted and the light as the final output of this elaborate process represents but a slight percentage of the whole applied energy. The temperature at which incandescent lamps are run is too low to admit of an efficiency that would solve the question, and too high to admit of an increase without the rapid deterioration of the filament. The turning point has been reached. Unless incandescent lamps are made with a filament that will stand a higher temperature safely, the production of light by means of heat, by the partial incandescence of carbon, is of so limited a nature that a few years will suffice to see it surpassed by either a fluorescent or phosphorescent means of illumination.

The incandescent lamp will predominate even in its present condition if the cost of power decreases, when coal is not burned in boilers to run reciprocating engines for the maintenance of the electric light.

The lines on which Nikola Tesla has worked are of deep scientific interest. In his paper treating of the "Reactions of Condensers," he has experimentally shown a method of illuminating a house by placing a vacuum tube between two plates electrostatically charged with constantly reversing polarities. In fact, the principle he depends upon—the use of high frequency currents for lighting—is productive of astonishing results. Some marvellous experiments have been performed by him illustrative of certain apparently paradoxical effects. The refusal of a wire to give issue to current except at certain points, the lack of danger attending a discharge of millions of volts, and the illumination of lamps having but a single straight bit of carbon connected at but one end; the use of high frequencies, of impulses surging through wires at the rate of 20,000 a second and over. From the effects of so rapid a change in the ether some of the phenomena of light may be produced in an exhausted tube. It is but necessary to understand the nature of light, and the object of such rapid reversals will be clearly seen. Light consists of infinitely quick movements of the ether. If these movements are effected by the interposition of another grosser medium heat is generally produced; in the gas flame, the incandescent lamp filament, or the small fraction of air remaining in a Giessler tube. To reduce the amount of material required, the go-between, as it were, is the great point in this highly advanced system. Some of Tesla's experiments are shown in the accompanying cuts, especially the system of lighting vacuum tubes without wires, between two large electrified plates.

McFarlan Moore has brought to a state of comparative perfection a means of illuminating houses by vacuum tubes. Its scientific exposition has been given in these pages with full description. In general, the improvement consists in the use of a "vacuum break"; a vibrator working in a vacuum and sending impulses of the proper rapidity into an exhausted tube. The light obtained is strong and clear, and intense enough to enable reading to be carried on without the least inconvenience; in fact, the

D. McFARLAN MOORE.

light is like the pure dawn with all its softness and uniformity. The phosphorescence of a body may also give rise to light or the fluorescence proceeding from the walls of a tube. Edison has constructed a lamp on this principle, which gives out light at a very high efficiency. The use of a fluorescing substance like that used in the X-ray apparatus (the fluoroscope) will probably be attempted for commercial purposes, but its use at present is very limited. The sources of light known to man are enumerated for the benefit of those desiring some data in this absorbing work. Light proceeds from

High Temperature—Flames.
Incandescent substances:
(a) Carbon,
(b) Metals,
(c) Rare earths.
Low Temperatures—Phosphorescent substances:
Glow worms, insects, fish, and, at present, the use of the electric light, which has but 1-6th to 1-10th the intensity of the sun, completes the list.

Artificial daylight is only obtainable by the use of exhausted tubes, or a material that will be excited to bright phosphorescence, electrically or otherwise. In France all the effects of moonlight are produced by exposing the inner walls of a room, coated with sulphate of zinc, to sunlight and then shutting it off completely. The mild, beautiful light is spoken of in the highest terms.

All the phenomena of light, ranging through its never-ending gradations, its tones and shades of color, are but the faster or slower movements of the luminiferous ether. To excite it to that degree of agitation necessary for the faintest as well as the brightest light, requires the presence of some coarser material. Without a medium upon which the ether can play, the keyboard of nature will give no light. It is only by intercepting these waves that we can obtain the light we need. Across the sky, light waves are passing in infinite quantities, but unseen in the ether ocean until displayed by some whirling orb crossing their eventful path.

Light is energy, and while we may measure the power consumed producing it, no one has ever measured the energy of light itself.

The problem of the day, however, still remains—light without heat—the creation of ether-waves, and their change into visible light by the intervention of as small an amount of material as possible. To produce commercial daylight this is required. Night will then lose its mantle, and the sinking sun give rise to the glories of a new dawn.

EVOLUTION OF INTERIOR CONDUITS FROM THE ELECTRICAL STANDPOINT.

BY LUTHER STIERINGER, M. I. E. E.

(Continued from Page 366.)

In the United States, prior to 1860, neither water nor gas distributions in buildings, especially in residences, were very extensive. The vitiating effects of gas on the atmosphere of a closed room prevented its use in Europe until a comparatively recent date, except in corridors, assembly rooms, factories and public places. Sleeping apartments are still rarely supplied in England. In this country, however, at the period mentioned, gas was much more extensively used both in residences and elsewhere.

At one period, when cast-iron street mains were very expensive and costly as compared to present prices, several attempts were made to substitute pipes of other materials. In a city in the western part of England, an extensive trial was made of tranmitting gas through brick conduits and earthenware pipes, like the drain pipes of the present day. Pipes of earthenware were used on an extensive scale in some towns in France, the joints of which were made of Roman cement, and the services attached by punching a hole in the main and inserting the end of a leaden service pipe which was secured with cement. This method resulted in complete failure, and several gas companies were all but ruined by resorting to it. The excessive cost of cast-iron retarded gas as well as water distribution, enforcing even the use of wood coated with asphaltum as conduits for street mains. During the infancy of street gas distribution, cast-iron pipes were made with flanges and put together with bolts and cardboard washers. This practice had to be abandoned and lead joints were at length universally employed. The same method was adopted in water mains. The first street mains for gas, laid in 1807, in Pall Mall street, in London, were of lead. Tinned iron and copper were also used. Paper pipes were in use early in this century for water and gas mains. When used for the latter purpose, they were lined with lead to prevent the hydrocarbon in the bitumenized paper from being acted on. Tile pipe as large as 12 inches in diameter was also used.

Early plumbing did not comprehend any installation beyond water required for culinary or other special purposes; the introduction of the bath and more lavish use of water only following the more plentiful supply from comprehensive "Central Station" water systems.

It is not many years ago that water had to be drawn from wells and other sources and carried to receptacles for short storage. Where the luxury of a bath was introduced years ago, it was installed in an outhouse, or an extension to a dwelling or a building, to simplify and reduce the cost of installation. This generally required an extension of the pipes to serve points distant from the street service. For this purpose lead pipe only was used, which caused much annoyance and trouble. The settling of the soft, pliable pipe if not thoroughly supported, prevented a thorough drainage; and in cold weather the pipes were constantly freezing and bursting. This was the origin of the plumber-millionaire joke.

The use of saws, chisels and nails, by mechanics in the performance of their work, proved to be a constant source of injury to the pipes, and as these injuries frequently occurred when the water was turned on, great damage was done to frescoings and furnishings before the source of leakage could be discovered and corrected. Rats and mice would also frequently gnaw into such conduits and cause the escape of the water.

One of the first deviations from the lead-pipe practice on an extensive scale was in the latest Western Union Telegraph Building, in New York, on Broadway, in 1870.

To avoid the difficulties before mentioned, this building was piped with tin-lined brass pipes. From that time on, the practice became general of using in all concealed spaces galvanized iron or brass pipe that could be relied on as a safeguard against any of the aforesaid difficulties, so that damage might be avoided.

This is another form of distribution now in general use. It is effected with perfect safety when installed according to modern practices, with metal pipe of sufficient strength to withstand the pressure from within and injury from without.

In the three systems of distribution, which have been outlined as briefly as possible, viz., gas, water and steam, the following should be noted:

Water produces damage only when allowed to escape, and then only by flooding interiors.

Steam is so well harnessed that its escape in a measure does not differ materially in the results developed by water, except that it may cause personal injury through scalding.

Gas, however, unharnessed and not properly confined, is capable of two-fold destruction: 1st. Its ignition may set fire to surroundings; 2d. Its explosiveness, when pocketed and under suitable conditions. It is also extremely poisonous when escaping and unlit.

It is very rare that dislocation or deterioration in gas piping results harmfully in properly installed systems of gas piping in interiors.

The fixtures, of course, are more or less handled, and are liable to derangement, but as they are thoroughly accessible and in full sight, any leaks are easily discovered and corrected.

In 1881, upon the introduction of the incandescent light, which was designed to supplant gas systems, the promoter's contention, outrunning the inventor's more modest claims, was that the new electrical illumination required the simplest kind of wiring at small cost. The purchaser's objections to duplicating a system of distribution in a building already containing gas piping, induced the promoter to make further statements in the

direction of cheapness, which culminated in the claim that the gas pipes already in place could be utilized, and that the electrical conductors could be inserted within them. This was inexplicable to the purchaser, who was told—what at that time became a standing joke—that Mr. Edison had devised an electric bug, and all that was necessary was to attach a wire, insert the bug in the pipe and turn the current on, and it would crawl along and carry the wire with it to any required destination, thus enabling the wire to be placed without difficulty and at little cost. As a matter of fact, Mr. Edison was trying to get the "bugs" out of the system.

(To be continued.)

AMERICAN STREET RAILWAY CONVENTION OF ST. LOUIS.

The American Street Railway Association have decided to give an exhibition during the time of their meeting. The light and spacious hall will enable the exhibits to be set forth to great advantage. The building chosen is the one in which the Republican convention took place. It is of sufficient size to give lots of room, being 260 feet long and 180 feet wide. In the sketch the frontage on Clark street is shown lying between 12th and 13th streets.

The crowd that is expected will contrast very favorably with that present when McKinley was nominated. The entrances provided for by the Committee of Arrangements will be sufficient in number to accommodate the heavy influx and efflux of visitors. The large 13th street entrance will be used for the main opening. If there are no fires or panics the doors all over the building will remain locked, except on 13th street.

In the plan of the floor, seen in the illustration, the division of the space into two parts is clearly seen. One, the Convention Hall; the other, the Exhibit Hall.

The most cumbersome machinery will be arranged upon the lower part of the hall, while the apparatus that is easily handled will be in open view on platforms, etc. The supply of power for exhibitions of moving machinery will not be lacking. The railway men are satisfied so far that everything will run smoothly, and do not doubt the good time in store for all. No noise will inconvenience those in the meeting-room, because the machinery causing vibration or noise will be run at the further end. The visitor can prepare for a treat. When he enters the hall the entire series of exhibits will be exposed to view.

The decorations and lighting are going to be beautiful, and the convention will prove a source of deepest satisfaction to all.

CONVENTION BUILDING.

An Oxygen Lens.

Professor Elmer Gates has made a very interesting discovery that may add much to the science of astronomy.

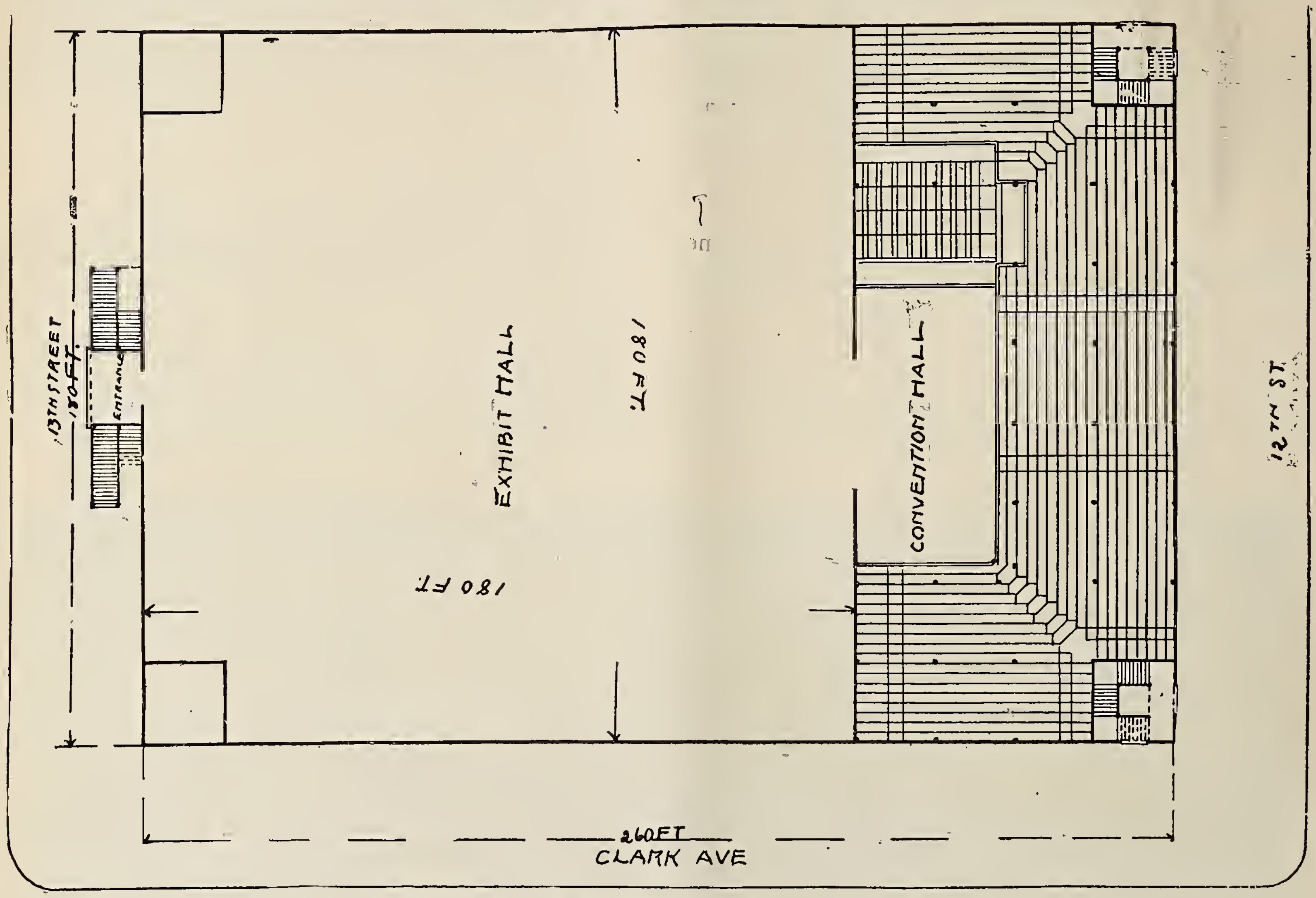
Having ascertained that oxygen is subject to magnetic influence, he creates a gigantic lens for telescopic purposes out of it.

Professor Gates converts an iron tube into a magnet, winding around it fine wire, and having filled the tube with oxygen gas, seals the two ends with glass. The molecules of oxygen are made to concentrate themselves close to the inside surface of the enclosure, under the force of the magnetic attraction, leaving the central core of the enclosure less dense than any other point. The molecules distribute themselves, it is said, in mathematically increasing degrees of density—from the centre to the circumference. The rays of light striking this medium are said to be magnified in the same way as by a glass lens, and as a glass lens is practical to a certain limit of size only, Professor Gates thinks an acceptable substitute for it can be made of oxygen of any desired dimensions. —Progress of the World.

Wonders of Sulphate-of-Zinc Light

Another conquest of light, says the London "Daily News," is M. Charles Henry's sulphate of zinc. M. Henry is a French savant of the school of higher studies, who has revealed the power of sulphate of zinc to absorb sunlight and give it back in the dark. Poudre de riz made with this mineral gives a soft luminosity to a fair

young face. A lady cyclist dusted over with this powder is in herself a lamp on a pitch-dark night. The luminous pigment is not liable to be spoiled by damp, by carbolic acid nor by any weak acid. It resists rain if united to some strongly adhesive body. There is a house in the Rue de Longchamps where a windowless set of rooms is lighted with it. The lady of the house receives there her friends at "5 o'clock." The apartments seemed bathed in moonlight, and the curtains are as if studded with glowworms, the ceiling scintillates. The furniture looks as if rubbed with phosphorus. The play of this light on colored objects gives one the impression of Aladdin's underground palace. Often they take the rich, glowing tones of the topaz, ruby and emerald. The powder does not lose its brilliancy if used in starch or size.—Progress of the World.



PLAN OF CONVENTION HALL.

THE STILES AND FLADD PRESS CO.

The Stiles and Fladd Press Company, of Watertown, N. Y., have improved upon the Stiles press to a great extent in placing before the public the press represented in the following cut.

The first-class workmanship exhibited in the construction of this press fully upholds the claims of its manufacturers. The heavy castings used are not of ordinary iron, but consist of a special mixture which adds an element of great strength.

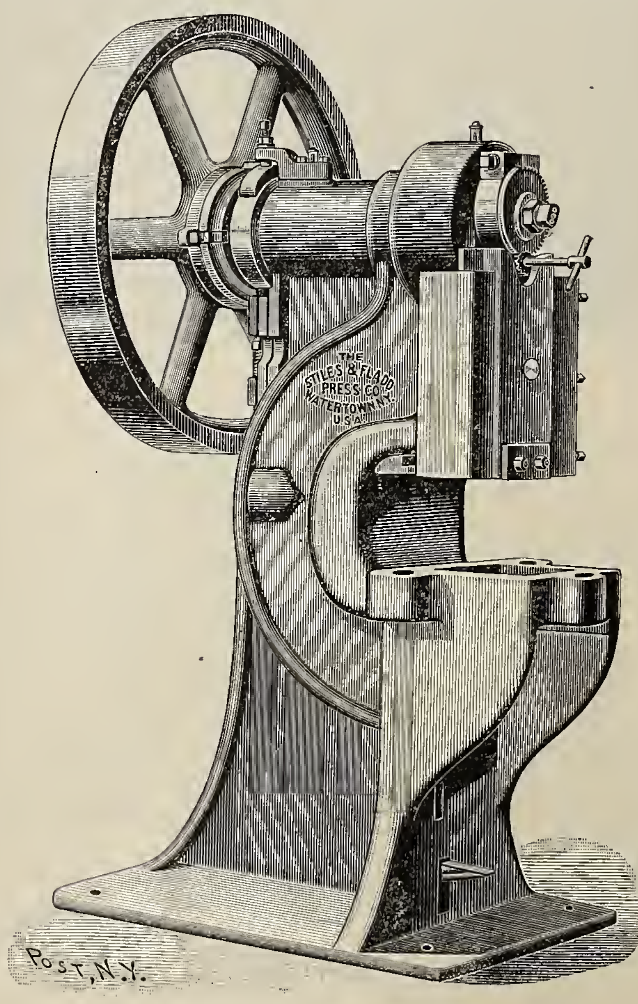
In this press the most severe shocks must be withstood, and it is only a most careful fitting in the joints that will prevent a rapid deterioration. The press can be looked upon as superior to others in several respects. The guides are made so very long that any lateral motion is completely prevented. The ability to run the press in either one way or the other—back and forth—by an instantaneous clutch, allows of perfect control.

This last feature alone is exceedingly valuable, as it enables the attendant to stop at any instant, whether the blow is complete or not. If Emperor William was alive he would be able to repeat the experiment he tried on a past occasion with a diamond-studded watch. The timepiece was placed on the die plate and the hammer, descending with terrific force, was stopped a hairsbreadth above it. The presses vary in size as follows:

Fly.....Six sizes, weighing from 500 to 7,500 lbs.

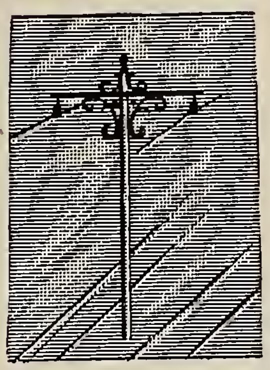
Geared..Five sizes, weighing from 1,200 to 8,000 lbs.

The Stiles and Fladd Press Company will produce a press for any purpose whatsoever, and guarantee its durability and finish.



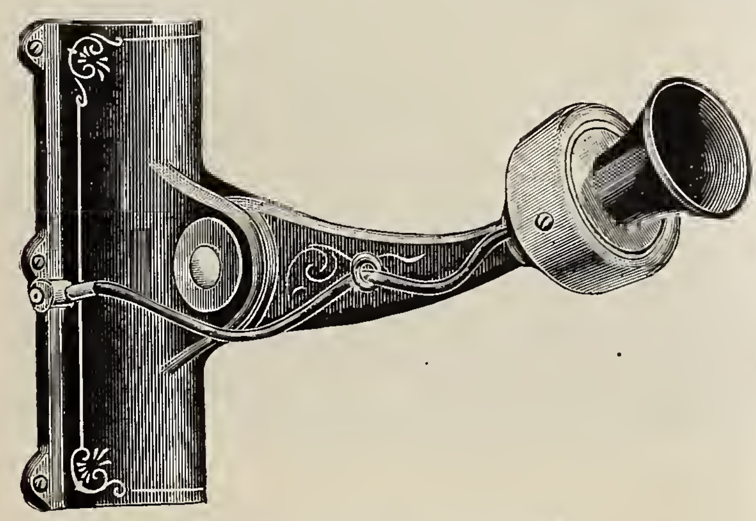
STILES AND FLADD PRESS.

MIANUS ELECTRIC CO.



The Mianus Electric Company have placed upon the market one of the finest transmitters in the land. Like a cross wife, it is a loud talker—perfectly distinct in enunciation and lacking almost entirely in induction. The Mianus Company make it look very neat; they use the best enamel and give it two good coats. The finish of the instrument is remarkably fine. They use granular carbon to give the voice the timbre and volume that it needs. It swings on an arm for convenience sake, giving by that means a valuable adjustment for the short man and the tall. A very strong induction coil makes it additionally valuable. The art of making telephones is now old, but the improvements are always new.

It is without doubt the most excellently constructed transmitter we have seen. A cut also shows the outfit complete, including transmitter, receiver and battery-box. The use of a Mianus outfit has always been attended with satisfaction. They take great pride in their



GRANULAR CARBON TELEPHONE.

work and try to assist their customers as much as possible. The management is well conducted, and their business methods without a blemish.

A very nicely finished electric-alarm clock is sold by them. "You probably know the faults of the regular alarm clock. The first is that the alarm does not ring long enough to always wake the sleeper. The second fault is not the clock, but the fault of the person it wakes, as after it stops ringing one is liable to go to sleep again. But with the electric-alarm clock this cannot happen, as the alarm will ring all day if not switched off. The person has to get up to switch it off, and once out of bed will stay out."

You will at once receive attention if you desire to establish telephone lines. Their address is Mianus Electric Co., Mianus, Conn.

New Corporations.

Augusta, Ga.—The Augusta Street Railway and Electric Co. has been organized by A. D. Chandler, B. Wright and others. Capital stock, $50,000.

Chicago, Ill.—Standard Incandescent Lamp Co. Capital, $10,000. Incorporators: Alfred E. Manning, Charles M. MacLaren and Josiah Gratty, 183 Madison street.

Alexandria, Va.—Judge Norton granted a charter to the Fairfax Construction Co., the objects of which are to construct railways, dams, power plants, etc. Capital, $25,000. G. L. Boothe is to be agent in this city. G. S. Gandy, of Philadelphia, is president.

New York City.—At a meeting of the Sinking Fund Commission, in the Mayor's office, plans were submitted by Architect James Brown Lord for a new building for the Appellate Division of the Supreme Court, at 25th street and Madison avenue. The estimated cost of the building is $700,000.

Kingston, N. Y.—The State Railroad Commission has granted an application of the Kingston and Lake Katrine Railroad Company to construct an electrical road from Kingston to Lake Katrine.

New York City.—Architect John B. Thomas was instructed to draw plans for a new hospital on Gouverneur Slip, to take the place of the present Gouverneur Hospital, the cost of which is not to exceed $200,000.

Possible Contracts.

New York City.—Barnard College, 125 E. 35th street. will erect a four-story brick college building on Boulevard and Claremont avenue, at a cost of $132,000.

Middletown, N. Y.—Columbia Park is soon to be lighted with electricity.

NEW TELEPHONE COMPANIES.

Greenville, Miss.—The Mutual Telephone Co. has been chartered. Capital stock, $5,000. Incorporators: L. Watson, L. J. Mittinger and J. M. Jayne.

Sulphur Springs, Tex.—The North Texas Telephone Co. has been incorporated by R. C. Hawley, J. D. Williams, J. F. Quinn and Luther McLemore. Capital stock, $10,000; to construct telephone systems, etc.

Salmon City, Idaho.—Articles of incorporation of the Red Rock and Salmon City Telephone Company have been filed with the secretary of state. The company proposes to construct and maintain a complete telephone system in Lemhi county. The line will be extended to Red Rock, Mont. Capital, $20,000. Incorporators: Emerson Hill and H. C. Lewis of Red Rock; E. J. Wilkinson and others of Salmon City.

TELEPHONE PATENTS.

ISSUED JUNE 9, 1896.

561,601. Register for Telephones. Edwin L. Morey, Portland, Ore. Filed Aug. 13, 1895.

561,619. Toll-Counter for Telephone Lines. Gustave P. Seligmann-Lui, Paris France. Filed Aug. 18, 1894.

New York Notes.

The Central Electric and Foundry Co., general contractors and manufacturers of the highest grade electric motors, dynamos, power generators, and electric light and power installation, have a fine office at 27 Thames street, Thames Building, New York. Mr. G. W. Euker is the agent. Their works are at Lewisburg, Pa., and East Orange, N. J..

Douglas, Ga.—A telephone line will be constructed to MacDonald's Mill by E. A. Buck and B. Peterson.

Brownwood, Tex.—Address Weakley & Watson for information regarding the long-distance telephone system which is projected.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued June 9, 1896.

561,560. Electric-Arc Lamp. Sigmund Bergmann, New York, N. Y., assignor to the General Incandescent Arc Light Company, same place. Filed Feb. 27, 1895.

561,565. Automatic Electrical Battery Cut-Out. Harry W. Clelland and Frank J. Madden, Wilkinsburg, Pa. Filed Dec. 11, 1895.

561,581. Electric Switch. Monroe Guett, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company, same place. Filed Nov. 29, 1895.

561,588. Electric Switch. Julius L. Hornig, St. Louis, Mo. Filed Aug. 26, 1895.

561,590. Armature for Dynamo-Electric Machines. Francis P. Ide, Eau Claire, Wis. Filed Apr. 14, 1896.

561,593. Dynamo-Electric Generator. Benjamin G. Lamme, Pittsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Sept. 4, 1895.

561,636. Form for Winding Armature-Coils. James A. Webber, Lynn, Mass., assignor to the General Electric Company, of New York. Filed Jan. 25, 1896.

561,653. Telegraph-Relay. Edwin Butler, New York, N. Y. Filed June 15, 1893.

561,657. Thermo-Electric Generator. Harry B. Cox, Hartford, Conn. Filed Feb. 13, 1895.

561,695. Spark-Arrester. Joseph T. Bright, Midway, Ky. Filed Dec. 3, 1895.

651,699. Electric Motor. William H. Cooley, Brockport, N. Y. Filed Mar. 12, 1895.

561,700. Electric Motor. William H. Cooley, Brockport, N. Y. Filed Mar. 12, 1895.

561,711. Electric Meter. Ralph O. Hood, Danvers, Mass. Filed Jan. 26, 1895.

561,735. System of Electrical Distribution. Charles P. Steinmetz, Lynn, Mass., assignor to the General Electric Company, of New York. Filed Jan. 6, 1894.

561,777. Electrical Apparatus for Controlling Motion of Cranes, Etc. John A. Essberger and Alexius W. Geyer, Berlin, Germany. Filed Sept. 29, 1894.

561,803. Dynamo-Electric Machine. Fritz G. Mayer, Chicago, Ill. Filed Oct. 18, 1895.

561,810. Electric-Battery Element. George J. Ortner, Pueblo, Colo. Filed Feb. 18, 1896.

561,821. Electric Railway. William M. Schlesinger, Philadelphia, Pa., assignor to John I. McDuffee, trustee, same place. Filed Aug. 4, 1885.

561,828. Electric Elevator. Humphrey R. Smith, Chicago, Ill., assignor to the Winslow Brothers Elevator Company, same place. Filed Mar. 16, 1896.

561,830. Electric Railway. Charles E. Stanley, Gallipolis, O. Filed Sept. 27, 1895.

561,838. Arc-Interrupter for Street-Car Controllers Gustaf Valley, Cleveland, O., assignor to the Steel Motor Company, same place. Filed Feb. 10, 1896.

561,839. Reversing and Cut-Out Switch Used in Electric Street-Cars, Etc. Gustaf Valley, Cleveland, O., assignor to the Steel Motor Company. Filed Feb. 26, 1896.

561,846. Automatic Motor-Stop. William M. Wood and James C. Miller, Elmira, N. Y., assignors to the Elmira Safety Appliance Company, same place. Filed Oct. 21, 1895.

561,847. Automatic Motor-Stop. William M. Wood and James C. Miller, Elmira, N. Y., assignors to the Elmira Safety Appliance Company, same place. Filed Oct. 21, 1895.

561,867. Electric Motor and Motor-Generator. William H. Cooley, Brockport, N. Y. Filed May 21, 1895.

561,872. Electrical Accumulator. Gaston de Schrynmakers de Dormael, Brussels, Belgium. Filed May 1, 1895. Patented in Belgium, May 12, 1894, No. 109,-940; July 7, 1894, No. 110,857; July 11, 1894, No. 110,-935, and July 17, 1894, No. 111,003; in Germany, Oct. 6, 1894, No. 82,711; in France, Jan. 7, 1895, No. 244,-138; in England, Apr. 18, 1895, No. 77,095, and in Luxemburg, Apr. 18, 1895, No. 2,286.

561,878. Galvanic Battery. Thomas E. Fogalsang, Sacramento, Cal. Filed July 29, 1895.

561,881. Electric Chime. James H. Gerry and Frederick M. Schmidt, Brooklyn, N. Y., assignors to the Self-Winding Clock Company, New York, N. Y. Filed Mar. 18, 1895.

561,886. Electric Igniting Device for Gas or Petroleum Engines. Arthur A. Hamerschlag, New York, N. Y. Filed Feb. 17, 1896.

561,898. Electric Railway. Paul W. Leffler, Chicago, Ill., assignor to the Leffler Electro-Magnetic Railway Company, same place. Filed Aug. 12, 1895.

561,899. Cintinuous-Current Rectilinear Motor. Paul W. Leffler, Chicago, Ill., assignor to the Leffler Electro-Magnetic Railway Company, same place. Filed Oct. 8, 1895.

561,918. Electrical Measuring Instrument. Henry A. Rowland, Baltimore, Md. Filed Oct. 2, 1895.

561,919. Electrical Measuring Instrument. Henry A. Rowland, Baltimore, Md. Filed Oct. 2, 1895.

561,943. Electric Self-Winding Clock. Robert A. Mitchell, Brooklyn, N. Y., assignor to the Self-Winding Clock Company, New York, N. Y. Filed Jan. 16, 1895.

561,951. Electrical Connection. Theodore Grutting, St. Paul, Minn. Filed Aug. 19, 1892.

The Electrical Age.

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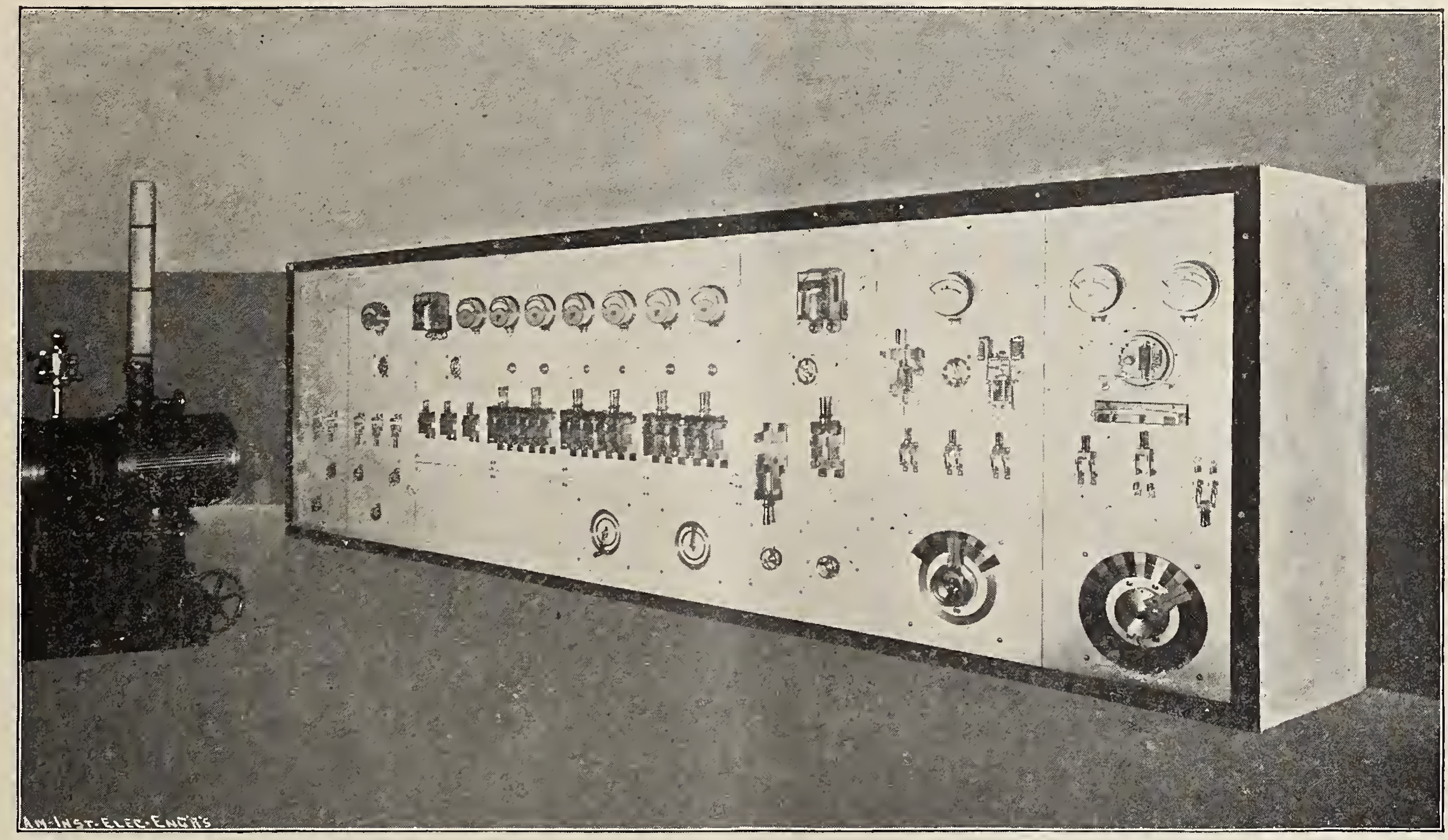


FIG. 4.

THE RECONSTRUCTION OF THE PLANT OF THE CHICAGO BOARD OF TRADE.

By Bion J. Arnold.

When the writer agreed some four weeks ago to prepare a paper on the reconstruction of the plant in question he hoped to be able to present to the Institute to-day some records of its operation, or data which would be of value, but owing to the delay in the arrival of certain parts of the plant, the question of operating it a sufficient length of time to secure such data proved impracticable, and not wishing to appear before this body with any data the completion of which did not extend over a sufficient length of time to make it reliable, he must confine himself to-day practically to a description of the plant, with the expectation of presenting to this Institute at a later date the records of its operation, in a form which he hopes will be of some permanent value. The plant involves a number of departures from the standard lines of office building engineering, and if the results of the operation are as successful as it now seems, after running a sho t period, that the annual expenses of the operation of the plant will be reduced from $25,000 to $15,000, and consequently the results obtained from its operation will be watched closely by the members of the Board of Trade who have the matter immediately in charge.

The writer believes that all the energy required to produce motion and light in an office building should be developed in one set of steam engine cylinders and on one generator. This set of cylinders, together with the working parts of the engine and its generator connected directly to it, constitute the unit which produces the energy of the plant, and this unit should be made to work at its maximum economical load throughout its entire period of operation, while the energy from the unit should all be utilized during its running time. Having this idea constantly in view, the designer of this plant has planned to follow it out as closely as possible.

The old plant consisted originally of six horizontal tubular boilers operating at a steam pressure of about 75 to 80 pounds, and driving five small steam engines distributed in different parts of the building, together with the necessary steam pumps, air compressors, etc., used for feeding the boilers, and operating the hydraulic elevators. Two of these engines were belted to a line shaft and drove several small incandescent and arc dynamos for lighting the building. The three other engines were used for driving the ventilating fans, three of which were located in the attic and two in the basement, and were driven by the engine by means of rope-drivers with sheaves and ropes running at various angles throughout the building. The elevators were driven by two horizontal compound direct-acting pumps, which consumed from 80 to 100 pounds of water per horse-power of energy delivered to the elevator cars. It became apparent after an examination of the plant that if the steam pressure could be in-

creased to 125 pounds per square inch, so as to get the advantage of drier steam, and all the pumps in the plant which were consuming steam full stroke eliminated, and the energy of the plant produced by a compound condensing engine running at an economical load, that a large reduction in the operating expenses of the plant

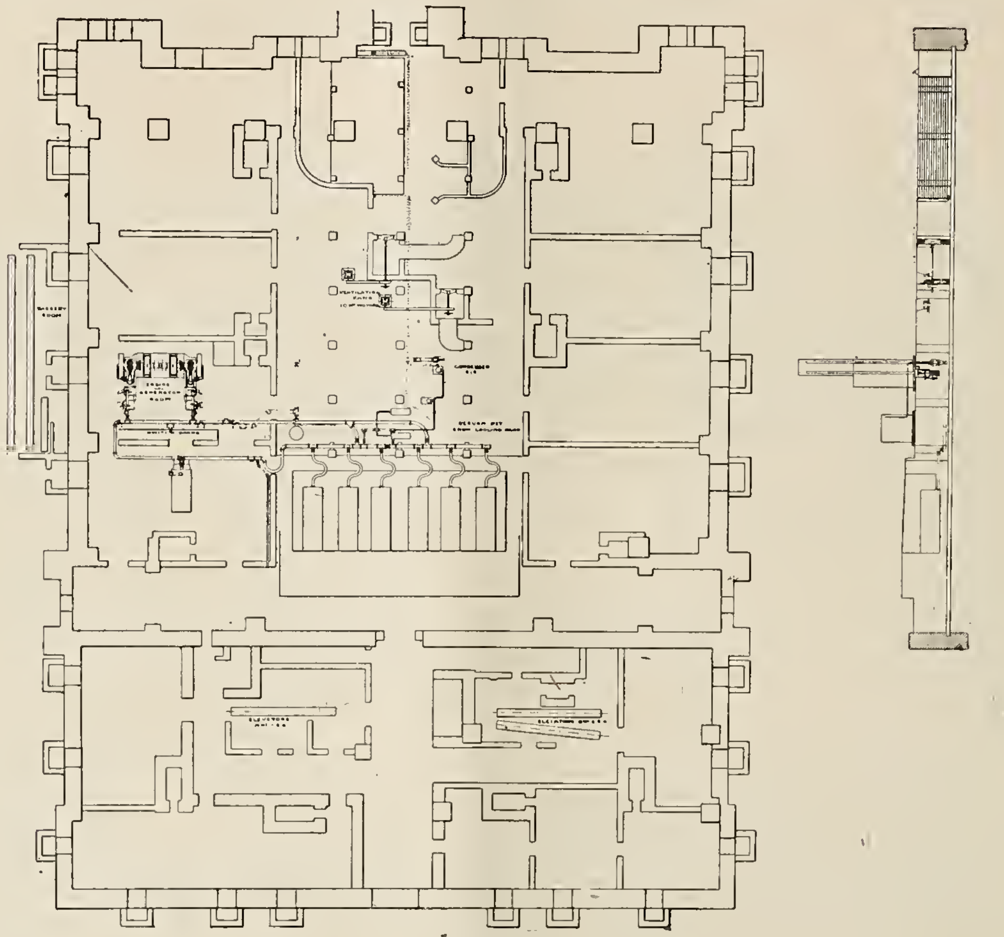


FIG. 1.

could be effected. The old boilers having been in use for about ten years, were almost ready to be condemned by the boiler inspectors, consequently it was an easy matter to decide upon replacing the boilers with heavier ones which would work at the above pressure. The adoption of a compound condensing engine to work under this

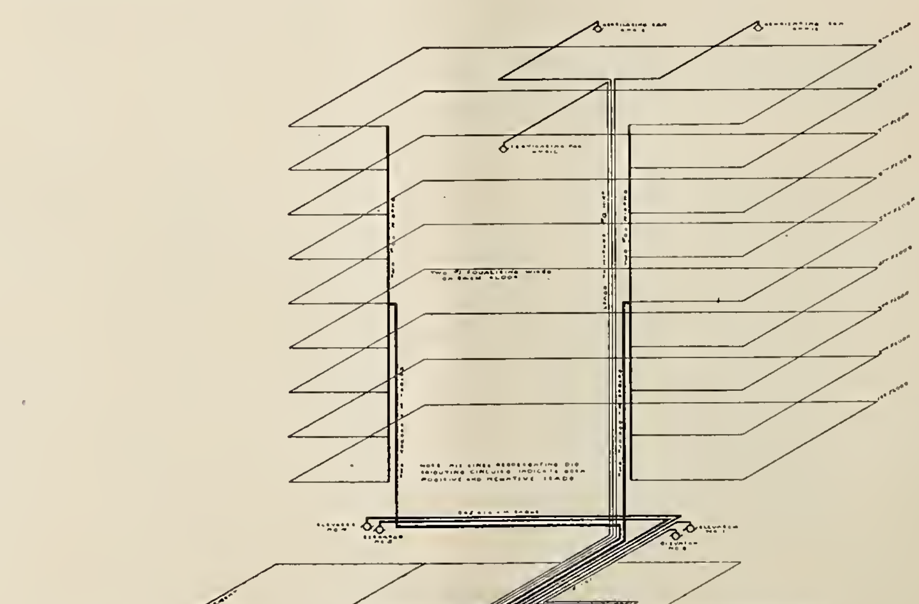


FIG. 2.

increase steam pressure was a natural sequence which enabled the energy to be produced with the least possible coal consumption. After quite an extensive investigation it was decided to supplant the hydraulic elevators with horizontal screw multiple sheave elevators, as the investigation showed that these machines could be operated for considerable less money per car-mile than the hydraulic machines, under the conditions which existed in this plant. The operation of these elevators in practice has fully proven the correctness of this position. They have been in operation about four months now, on an average consumption of $4\frac{1}{4}$ kilowatt-hours per car-mile, and as the duty required of them is conceptionally heavy, and the cars very large, this showing is very satisfactory.

The general plan of the plant is as follows:

Referring to Fig. 1, which represents the basement of the Chicago Board of Trade, the relative location of the different machines which enter into the plant can be determined. It will be seen that the installation consists of the following: Five 66x16-ft. horizontal tubular boilers, designed to carry 125 pounds pressure per square inch; two 150-HP. horizontal compound condensing engines running at 275 rovolutions per minute, each directly con-

nected to a 75-K.-W. direct-current generator, under a special system devised by the writer, and hereinafter described, which permits of either or both generators being driven from either engine. Four horizontal 30-HP. multiple sheave elevators; six 10-HP. electric motors, five of which operate ventilating fans, and one the machinery in the machine shop. There are also sixty-five 1,600 ampere-hour storage cells, and the necessary switchboard and connections for the handling of the above machinery, all of which is more distinctly described hereafter. One of the compound steam pumps has been retained in order to keep the tank on the roof of the building supplied with water for use in the wash-basins, closets, etc. It may prove advantageous in the future to substitute for this an electrically driven pump, but it has been thought best not to discard the old one at present, inasmuch as it is already on hand.

Fig. 2 represents diagramatically the main leads or copper conductors of the building, used for the operation of the above described electrical machinery. The general plan is clearly shown by the diagram, and this system was adopted owing to the fact that the building was so constructed that two main flues or passageways extending from the basement to the attic, in opposite portions of the building, and near its centres, were available for carrying the main risers. It was decided to place in these passageways vertical risers of sufficient carrying capacity to carry the total amount of energy required for the nine floors, and to join the floor leads or secondary mains unto each of these risers are at their ends. With this arrangement it was possible to feed the secondary mains at two independent points, thus equalizing the pressure to better advantage and making the plant more reliable in operation. From the centre of these vertical risers, or at about the fifth floor, the main leads drop

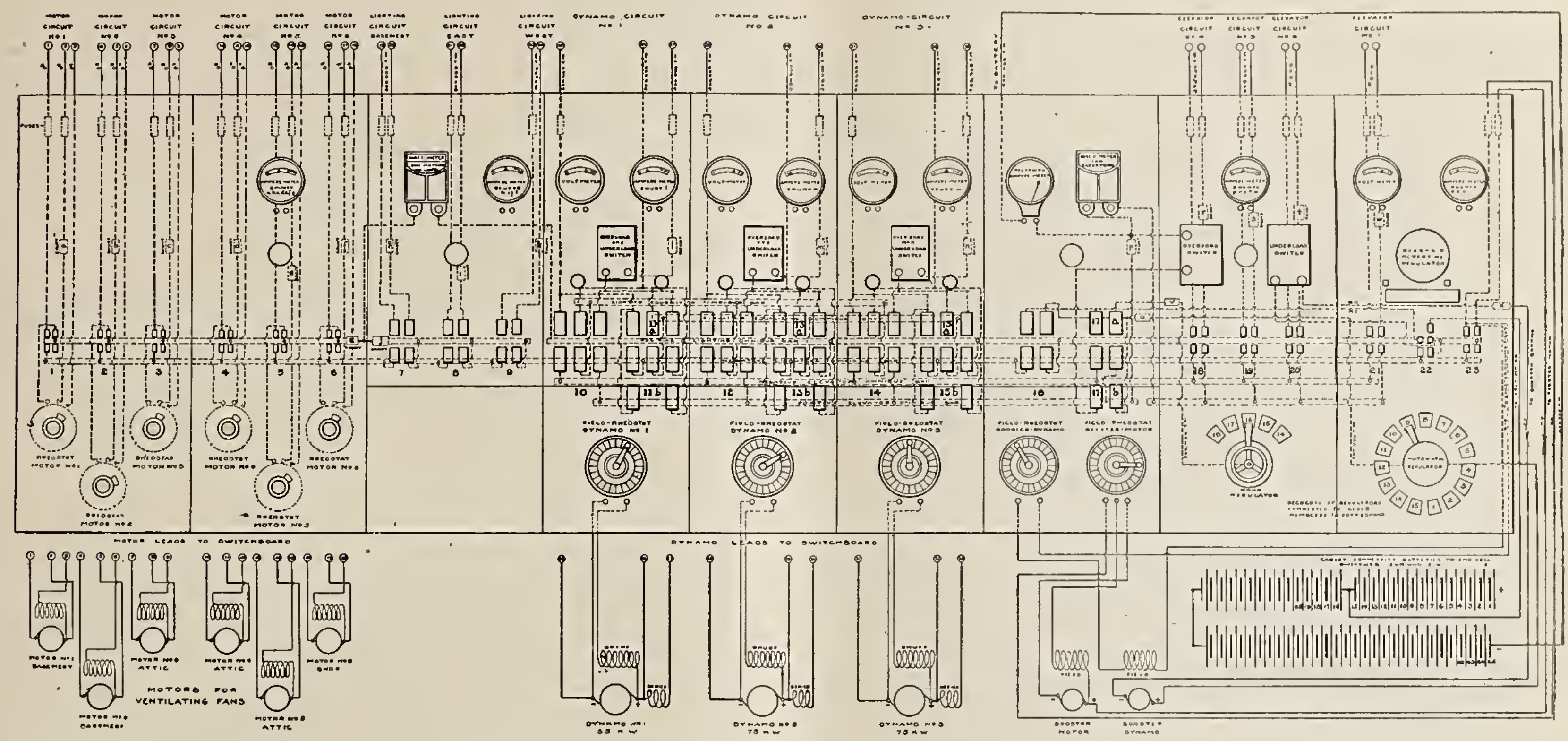


FIG. 3.

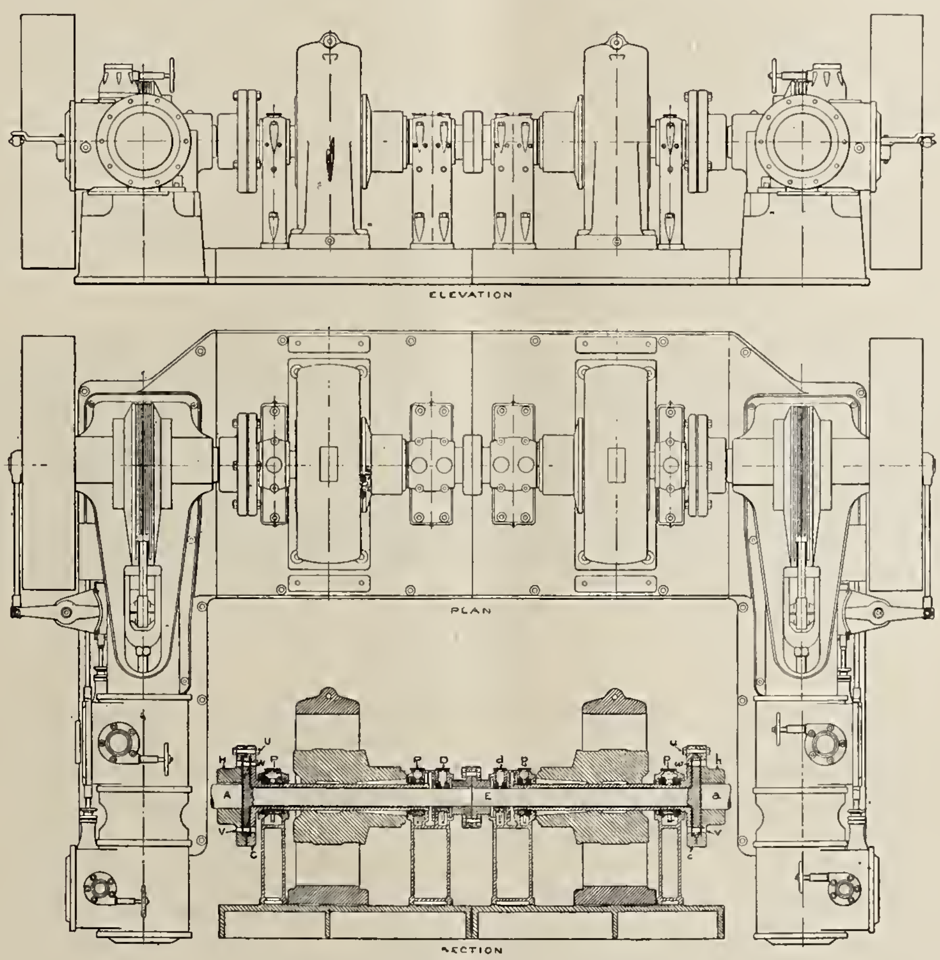
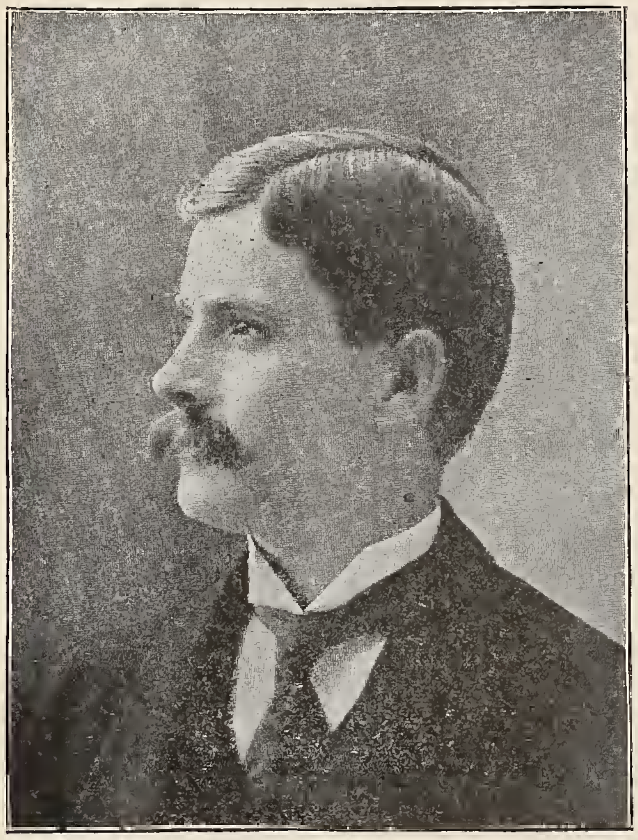


FIG. 5.

down each shaft, thence extend horizontally on the ceiling of the basement to the switchboard. Each of these mains which lead to the centre of distribution in each shaft are of sufficient carrying capacity to carry the total load of the building, exclusive of the basement, consequently if a fuse blows on either one of the mains, or if by any accident one of the mains should become broken or opened, the other main will carry the necessary current and keep the lights operating in the building. This precaution was taken owing to the fact that business matters



BION J. ARNOLD.

of great importance are transacted in this building, and the loss of a few minutes at certain times would be disastrous to the men who operate in the building, consequently every precaution for safety and reliability had to be taken.

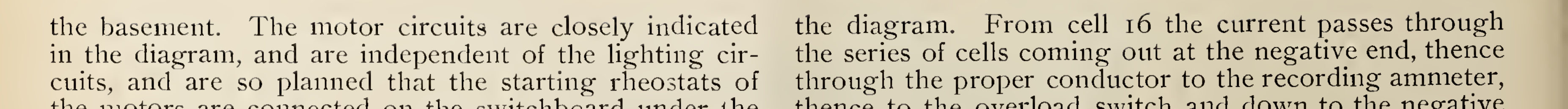
The basement circuit is independent of the above-described mains, and consists of positive and negative leads, surrounding the entire basement of the building, from which are tapped the arc and incandescent lights used in

tion to secondary mains, 1 per cent.; between secondary mains and lights 1 per cent.—making the total loss between generator terminals and lights, 5 per cent.

Fig. 3 represents largely diagrammatically the switchboard of the plant. From this it will be noticed that the plant is designed for 3 generators, but 2 of which are now in operation, as they are sufficient for the work. The lighting 'bus-bars carry the main lighting circuits, controlled by switches 7, 8 and 9, and also the motor circuits controlled by switches 1, 2, 3, 4, 5 and 6. In the main lighting 'bus-bars is placed the recording wattmeter, which registers all the energy delivered from the generator to the light and motor portions of the plant. In the elevator 'bus-bars is placed another recording wattmeter which registers all the energy delivered to the elevators from the lighting 'bus-bars. With this arrangement and the means available in the plant for measuring the amount of coal and water consumed, the operators are enabled to keep accurate daily records of the cost per kilowatt of the energy produced and delivered by the plant. The diagram of the switchboard clearly shows the windings of the different generators and motors, and need not be further explained.

The generators are connected to the board by means of two switches, one of which is a triple-pole double-throw switch, and is arranged so that when thrown into the upper position it connects the generator to the elevator 'bus-bar, using the compound winding of the generators. This arrangement permits the generator to operate the elevators and take care of the variable load without the use of the batteries. When the same switch, for instance No. 13 or 15 on the accompanying diagram, is thrown in its lower portion, the circuits are so arranged that the compound or series winding of the generator is cut out, and the equalizer connection from the generator becomes the positive connection, and the generator is connected to the elevator 'bus-bar's shunt-wound, thus eliminating its series winding. With this arrangement, the generators and the batteries are run in multiple on the elevator load.

Referring now to the right-hand part of the board which is the storage battery proper, the operation is as follows: Under normal conditions, any elevator is operated shunt-wound in parallel with the batteries by closing its corresponding switch, as, for instance, switch 15 for dynamo No. 3 downward the 15*b* position. By closing switch 17 to 17*a* position, the current passes from the positive elevator 'bus-bar to the hand regulating cell switch, and out to cell No. 16, when the regulator is placed as shown on



LOAD CURVE.

the basement. The motor circuits are closely indicated in the diagram, and are independent of the lighting circuits, and are so planned that the starting rheostats of the motors are connected on the switchboard under the control of the engineer, thus making it possible for the engineer to start or stop any motor in the building without leaving the switchboard. The elevator circuits are also independent of the lighting and motor circuits, and it is possible to throw the current on or off any elevator at the switchboard. The batteries are located in a room adjoining the main engine room, and connected with the switchboard, as shown on the diagram.

The losses in wiring circuits of the building are computed as follows: Between generator and switchboard, one-half of 1 per cent.; between switchboard and centre of distribution, 2 1-2 per cent.; from centre of distribu-

the diagram. From cell 16 the current passes through the series of cells coming out at the negative end, thence through the proper conductor to the recording ammeter, thence to the overload switch and down to the negative terminal of switch No. 17*a*. It will now be seen that whatever number of batteries are being operated in this series, are in parallel with the generator. The hand regulator is placed in the position indicated to enable the operator to cut in a sufficient number of cells in parallel with the generator, so that the cells will be constantly charging during the time of operation of the elevators, except at the temporary moments of overload caused by an excessive demand for current by the elevators. When this pull from the elevator occurs, the batteries respond and take the surplus load from the generator. With this arrangement about fifty of the cells will be kept con-

stantly charged, and in parallel with the elevators. In case the amount of current entering the cells is excessive between the intervals of heavy load on the elevators, the hand regulator is adjusted so as to cut in one or more cells until the current becomes reduced to the proper amount for the batteries; and on the other hand, if the amount entering the cells is not enough to keep them properly charged, the hand regulator is adjusted so as to cut out a number of cells until the proper amount of current is reached. In the meantime, if the 15-end cells require charging, they are charged by means of the independent booster or motor generator in the manner hereinafter described. All the batteries can be operated in parallel with the generators when running shunt-wound in the same manner as they are used in conjunction with the elevator 'bus-bars, by closing switch 17 downward to position 17*b*. The connections for same can be easily followed on the diagram.

In order to operate the batteries in parallel with both the lighting and the elevator 'bus-bars at the same time and maintain a practically constant voltage on the lighting 'bus-bars, it is necessary to operate the generators shunt-wound instead of compound-wound. As before shown, the switches are so arranged that the compound winding of the generators can be utilized when the batteries are not in service, and the shunt winding used when the batteries are being run in parallel with the elevators and lights. Therefore, to maintain a practically constant voltage on the lighting 'bus-bars and to run the elevators in parallel with the batteries at the same time, the operation is as follows: Switch 17*a* is closed upward and operates as previously described in conjunction with the elevators and batteries. Switches 10, 12 and 14 are open to prevent the generators operating compound-wound on the lighting 'bus-bars. Switch 16 is closed and the current passes as follows: From the positive elevator 'busbar through the switch 17*a* to the centre of the hand regulating switch, thence through the connection from the hand regulating switch to the corresponding cell (shown on the drawing as cell 16) thence through the series of 49 cells, out through the negative end and its corresponding connection, through the recording ammeter and overload switch, to the negative side of switch 17*a*, thence to negative elevator 'bus-bar. It should be borne in mind that the lighting 'bus-bars and the elevator 'bus-bars are operating at different potentials, and that the potential on the elevator 'bus-bars is changing slightly with the change of load, caused by variable load on the elevators. When the demand for current from the cells is great, as for instance when the elevator load is severe, the E. M. F. of the number of cells in parallel with the elevators necessarily drops, consequently the E. M. F. of the number of cells in parallel with the lighting bars, which includes all the cells working with the elevators, and a few of the regulating cells, would correspondingly drop, and some means must be provided to hold up the voltage of the lighting 'bus-bars. This is accomplished by means of the automatic regulator which is controlled by a solenoid switch, shown in the upper right hand portion of the diagram. This solenoid switch operates by means of suitable connections to the lighting 'bus-bars, in such a manner as to make and break the circuit through mercury cups as follows: When the voltage of the lighting 'busbars is reduced slightly, one side of the field of a right and left hand motor is thrown in, which causes the arm of the automatic regulator to move clock-wise, thus cutting in more cells in parallel with the lighting 'bus-bars and holding the E. M. F. up. When the E. M. F. of the lighting 'bus-bars reaches its proper voltage and tends to exceed it, the solenoid acts in the opposite direction and cuts in the left hand field of the automatic regulator motor, and brings the left hand field into service, causing the automatic regulator to rotate contra-clock-wise, thus cutting out cells until the voltage reaches the desired point. By this means a constant E. M. F. is maintained on the lighting 'bus-bars, and the cells are worked in parallel with both the lighting and elevator 'bus-bars.

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—CAUSE OF LIGHTNING.

St. Louis, Mo., June 30, 1896.

Dear Editor:—We have, as you well know, experienced a terrible storm in the past. I have since then become greatly interested in atmospheric disturbances, and especially in lightning and thunder storms. I am curious to know the cause and conditions giving rise to an electrical discharge in the clouds. I will be greatly obliged at your answering this question.

Yours respectfully, ARNOLD PARKER.

(A.)—The source of atmospheric electricity is to be found in the evaporation of water and the friction of water particles against ice. The first is universal, the ocean and inland lakes supplying a great deal of evaporated moisture. The rising of water vesicles into the air and their friction with ice particles also adds to the production of electrical charges.

Clouds are both negatively and positively electrified—negative clouds from fogs and positively charged clouds from vapor condensed in the higher regions. The lightning is the discharge occurring between clouds oppositely electrified or between a cloud and the earth. Lightning flashes may be from one to five miles in length. The pressure is enormous to cause this discharge, and its effects, so well known, would be considerably worse but for the distribution of the discharge by the many pointed objects always around. In the isolated country spots the lightning is unusually severe when it strikes. In towns and cities it becomes greatly dispersed. The thunder is due to a reverberation of the sound of discharge; being long and rolling when coming from a distance, or short and sharp in the immediate vicinity.

(Q.)—AIR SHIPS BY COMPRESSED AIR.

San Francisco, June 28, 1896.

Dear Sir:—Have been experimenting with balloons and air ships on a small scale; do you know of any case in which compressed air was used as the motive power for such vessels? Furthermore, have any vessels been built that used the screw propeller proper for propulsion?

Yours truly, F. L. MAYNARD.

(A.)—Compressed air, to our knowledge, has never been used for the purpose you describe. Steam power, electricity and even illuminating gas have been tried, but no compressed air. Screw propellers or their nearest imitation have been employed for the movement of aerostats. Prof. Langley, of the Smithsonian Institution; Tissandier, Renard and Krebs and others attempted to solve the problem with them. Good results are being daily expected.

FRANKLIN LEONARD POPE.

In Memoriam.

(Concluded from page 378.)

The difficult nature of this undertaking was well understood by his brother, Mr. Ralph W. Pope, then stationed at Quesnel, who wrote in his diary, March 5, as follows:

"Hudson Bay express, 12 days from Fort James, arrived, bringing letters from my brother's party, the latest dated Lake Tatla, Jan. 22. Major Pope and Blenkinsop were to start for the coast, via Connolly's Lake, on the 1st of February. I think it doubtful whether they succeed in reaching there, but if they do, they will probably reach New Westminster by the 1st of May."

[As a matter of fact, they left Tatla, Feb. 19, and arrived at New Westminster May 24, 1866.]

The "Alta-California" commented at the time upon Mr. Pope's achievements as follows:

"Major Pope has shown great energy in pushing this

survey through, resulting so favorably, and is entitled to much credit for his tact and skill in the management of the various Indian tribes in the Northwest, with whom he is on the most friendly terms."

His success with these treacherous nomads was foreshadowed at the outset. Mr. Pope called a grand council of the Indians, at Fraser Lake, and explained to them the object of his trip through their country, and in order to convey to their minds some idea of the nature of the telegraph, he strung a wire upon small poles, a distance of several hundred yards, and made a circuit with a portable intermediate battery, and pocket instruments. At one end of the wire, Mr. Pope arranged a pistol in such a manner that it was fired by the Indian chief closing the distant key. This performance was voted "great medicine," and was repeated many times, to the wonder and delight of the savages. The chief stationed some of his braves at the farther terminal of the circuit, to which end Mr. Pope also repaired, and without their knowledge the chief had Mr. Pope's brother, Ralph W., transmit a message asking for a piece of tobacco, which was promptly conveyed by a courier and presented to the chief, causing great astonishment and an immense outburst of "Chinook" jargon. This admirable "medicine" together with very generous gifts, particularly tobacco, the acme of an

WAINWRIGHT HALL,
(BUILT 1776. REMODELED 1890.)
Corner South Main and Pope Streets, Great Barrington, Mass.

Indian's desires, had a propitiatory effect, and elevated Mr. Pope to a high pinnacle in the savage esteem.

While Mr. Pope was arranging the details at New Westminster, to explore the more difficult and dangerous part of his territory northward to the Yukon River, to meet an exploring party already started from its mouth to pierce the interior, and form a junction at its head-waters with Mr. Pope, he received the intelligence of the success of the Atlantic cable, and with his intimate knowledge of telegraphic affairs, and his late experience, he wisely concluded, in advance of the executive officials of his company, that the Russian overland enterprise was doomed for a long time to innocuous desuetude, and resigning his position, he reached New York in October, 1866. His record from that time on is one of close and intelligent study of law, and the complete circle of scientific subjects, and more particularly the application of electricity to telegraphy, railroad signals, and the numerous other industrial and domestic purposes.

Immediately upon his return, Mr. Pope resumed the contribution of original illustrated articles to "The Telegrapher" upon the method of working the Atlantic cable; the principles of duplex working, and other practical subjects of great moment to the rank and file of American telegraphers, who had, outside of that journal, but very meagre sources of information.

Mr. Pope ably filled the editor's chair of that paper from August, 1867, until February, 1868, when he resigned to devote himself to electrical engineering. In 1867 Dr. S. S. Laws invented an electrical instrument intended to exhibit the changes in the market prices of gold in brokers' offices and to be operated by wires from the gold exchange. The invention was entirely tentative until 1868, when Mr. Pope was secured to develop and manage the system, which, through his ingenuity, was soon placed in satisfactory operation, netting a large profit to the proprietor, besides laying the foundation for the immense stock reporting system of the present day.

In this year Mr. Pope commenced work upon the first edition of his "Modern Practice of the Electric Telegraph" which was issued in May, 1869, and advance sheets were thus commented upon by the Western Union "Journal of the Telegraph," of Feb. 1, 1869:

"We are not a little pleased to know that in about a month a book entitled 'The Modern Practice of Electric Telegraph' will be published. The author is Frank L. Pope, widely known as a clear-headed, practical, educated expert. He has devoted to the work great labor, and has illustrated all his topics, which were susceptible of it, by elegantly executed engravings, or cuts, and has followed exhaustively in his usual clear and succinct style the whole of the practical telegraphic operations."

This book met with instant favor both here and abroad, was translated into foreign languages, and up to the present time has run through 15 editions, each of which Mr. Pope enlarged to fully cover, at its date of issue, the latest developments in the art.

Mr. Pope resigned his position with the Laws Gold and Stock Reporting Telegraph in July, 1869, and shortly afterwards formed a partnership with Thomas A. Edison and James N. Ashley, under the style of Pope, Edison & Co., Electrical Engineers, with offices at Nos. 78 and 80 Broadway, New York. The first advertisement of this firm appeared in "The Telegrapher," Oct. 2, 1869, and its object was stated to be, to give professional attention to a variety of subjects, involving the use of electricity, also to patent applications, drawings, wood engravings, etc. Mr. Ashley was at that time editor of "The Telegrapher," and Mr. Edison in March, 1869, had resigned as operator in the Western Union Telegraph office at Cincinnati, O., and accepted a similar position with the same company in Boston. He had about this time invented a system of duplex transmission described and illustrated in "The Telegrapher" on April 11, and complete sets were advertised for sale by Mr. Edison in December, 1868. The following January he resigned in Boston, and came to New York to devote himself entirely to electrical inventions and became Mr. Pope's partner as above stated. The firm, after a brief existence, was dissolved in 1870, as was naturally to be expected by those who knew the make-up of its members. A joint patent on a single-wire printer, subsequently sold to the Gold and Stock Telegraph Co., was a familiar factor in patent litigation where it was generally known as the "Pope and Edison patent." The inventive genius of both Messrs. Pope and Edison led them into the same field, and it was inevitable that whatever discoveries, devices or suggestions they made, would be difficult to satisfactory allot.

Mr. Pope from this time on continued actively engaged in inventions and electrical engineering. He secured several patents, the majority of them being for a railroad semaphore block signal system, to fill a great need upon our trunk lines. He brought to bear on this important subject an exhaustive knowledge of it, together with good practical ideas, reinforced by his usual energetic application, which eventually resulted in the successful development of a reliable system.

In 1875, Mr. Pope was appointed patent expert and counsellor of the Gold and Stock Telegraph Co., and shortly afterward to a similar position with the Western Union Telegraph Co.

(To be continued.)

Parsons, Kan.—The general offices of the Kansas Telephone and Electrical Co. have been located at Parsons, where 175 instruments are already in operation. A line is also in course of construction to Labette City, Oswego and Chetoka.

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CONTENTS.

	PAGE
EDITORIALS	
A Low Watt Lamp	395
Compressed Air	395
Station Leaks	395
GENERAL SUBJECTS	
The Reconstruction of the Plant of the Chicago Board of Trade	389
Franklin Leonard Pope	393
Testing of Circuits	396
Evolution of Interior Conduits from the Electrical Standpoint	397
Atmospheric Electricity	399
MISCELLANEOUS	
Electric Welding With an Ordinary Cement	398
The World Moving Backward	398
Compressed Air for New York Street Railway	399
An Historic Electric Central Station	395
INQUIRY COLUMN	393
TRADE NOTES	
J. C. Vetter & Co	400
The Riker Fan Motor	402
An Ideal Engine and Eddy Dynamo	402
X Ray Supplies	402
Possible Contracts	403
Telephone Notes	403
NEW CORPORATIONS	403
New Telephone Companies	403
PATENTS	404
Telephone Patents	403

A LOW WATT LAMP.

It has been interesting to note the steps of progress in the construction of incandescent lamps. Founded upon principles that are sound and substantial, the manufacture of filaments has become a science. From a vast chaos of possibilities a few definite and valuable features have been selected. They have been combined together for the purpose of constituting a finished lamp. In part this effort has not failed, and yet in reality it only marks an epoch in lamp construction, a mere stepping stone to further efforts. Conclusions have been focussed down to a single point, which is to-day the guiding star of intelligent inventors.

How shall these be enumerated without calling forth a stern criticism? The opinion that the incandescent lamp is a commercial success is true. It has created a field for itself and become in many respects indispensable. The comfort and satisfaction its use engenders is a matter of common experience. Why, then, is it not popular in the home? If food and light are essential to domestic happiness, it would be consistent to choose the best, at least of light, and drive away the hampering shadows. The expenses of a home are such in many cases that the introduction of the electric light would not interfere seriously and increase them. The reason does not exist entirely here, but in a parallel channel. Gas costs one dollar and a quarter a thousand cubic feet; a five-foot burner will give sixteen candle-power for two hundred hours. The electric light would involve an expense of from one and a half to two dollars for the same amount of light. Unaccustomed as the majority of house owners are to the electric light, its absence is not felt in the home; but its introduction and subsequent removal would probably create a change of sentiment regarding it.

Its loss would be felt, and the difference between it and the disagreeable features of other illuminants become strikingly evident.

The home will receive the incandescent lamp when competition brings it to the door—when power becomes cheapened and allows this great and final distribution to occur; or when the energy at present consumed in a lamp is cut down to one-half.

The matter rests between these two probabilities—the production of power on a much more economical basis, or the use of lamps giving sixteen candle-power with a consumption of twenty-five watts.

COMPRESSED AIR.

Considerable discussion has been excited in certain quarters on the subject of compressed air. Its value as a means of locomotion and adaptability for general traction purposes have again called forth criticism from several quarters. The Metropolitan Traction Company seem to believe it possesses new and important elements which have long remained hidden.

Compressed air cannot compete with electricity or steam except under certain circumstances. As a source of power for traction we have but little to say, except that the past will point like an index finger to the future. A history of its applications will convince the most sanguine that the enthusiasm which has hitherto sustained all worthy efforts must collapse, as its limitations become understood and known.

STATION LEAKS.

The value of an engineer is put to a test when a large plant, costing thousands of dollars, is placed under his inspection for the discovery of commercial leaks. The construction of a station, the installation of engines and the distribution of dynamos requires forethought and experience.

Expenses that have persistently appeared may be vanquished completely by a careful survey of the conditions and the extirpation of power-consuming and fuel-wasting factors. They exist to a greater or less extent in all plants. If the expense, therefore, of an apparently well organized station seems unwarrantably large, beware of these selfsame leaks. Call in a competent engineer, and whether in engine or dynamo, boiler or fuel, it will be traced out and rigorously suppressed.

AN HISTORIC ELECTRIC CENTRAL STATION.

The armatures of the early Edison "Jumbo" dynamos, in the famous Pearl street station, in New York City, were 27 inches in diameter and 61 inches long, and each weighed nearly 10,000 pounds; the copper armature bars weighed 590 pounds. Each machine had 12 field magnets, of which 8 were connected to the upper hole-pieces and 4 to the lower; the copper wire on the magnets weighed 1,500 pounds, and the total weight of the magnetic circuit was something over 33,000 pounds. The base plate weighed 10,300 pounds, the dynamo 44,800 pounds, the engine 6,450 pounds, making the total weight of the complete unit 61,550 pounds. The progress made in dynamo construction since these machines—which were considered marvelous in their day—were built is shown by comparison with a modern slow-speed multipolar dynamo, which, of approximately the same capacity, weighs only one-fifth as much, occupies but one-third the floor space, and has a much higher efficiency. The

Continued on Next Page.

TESTING OF CIRCUITS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

To make a very rigid test of the insulation resistance of a house would necessitate the use of a mirror reflecting galvanometer and a set of standard resistance coils. For practical purposes, the advantage of a portable bridge with ordinary accessories over a finer and more sensitive outfit is obvious. The agent or expert of illuminating companies spends but very little time on the test. He can generally infer from the first result what the general character of the wiring is and report accordingly. Houses are wired at present in large cities with the best of insulated wire. Poor rubber covering is not satisfactory to the board of inspectors and cannot be accepted. It will deteriorate very rapidly and lower the insulation resistance of the house to an alarming degree. The use of conduits has prevented this to a large extent. The risk attending their use, which, however, can be easily remedied, lies in the condensation and general moisture with the tubes. By filling the ends with compound this is prevented. Conduits may be classified as follows:

Rubber or gutta percha conduit.
Paper conduit.
Circular loom conduit.

The rubber conduit has not been greatly used on account of its expense, both in first cost and installation. The paper conduit, saturated with asphaltum and covered with sheet brass, is extensively used. Under the heading of armored conduits may be placed—

Armored Conduits.
Brass "
Iron "

which enjoy the greatest prestige in the vicinity of New York. The iron or gas-pipe tubing is the safest and best, though most expensive.

Circular loom or flexible conduit has received a great deal of attention from contractors. The main difficulty, which is experienced in pulling a wire through it, is its liability to bend or kink.

It saves a great deal of time and can be twisted or turned almost any way, thus saving extra expense for joints.

The insulating value of the three respectively can only be determined by a careful test. Without doubt the iron-armored conduit is the best in the field for durability, strength and insulation.

*   *   *   *   *

The lighting circuit is constructed for the purpose of connecting the dynamo and lamp. The source of illumination ultimately resides in the lamp, and therefore must be considered from several standpoints, among which are

Life.
Watts per candle-power.
Illuminating power.

The test of incandescent lamps is comprised under the last three headings. A good lamp, which will stand wear and tear without rapid deterioration, and a high pitch of incandescence without destruction, satisfies many of the most important demands made. Unfortunately, the present lamp is of limited candle-power; that is to say, any greater light obtained from it than it is supposed to give will mean a sacrifice of its life. For instance, a sixteen candle-power lamp, run up to thirty candles, which would ordinarily last six hundred hours, will fall away to one-half as much, or less, if its light is continued at such a strain.

An illuminating source may be judged of by means of its light-giving qualities, its durability, and its efficiency. The physiological effect of the light is also very important; a red or yellowish hue is not desirable if too pronounced, or, in fact, any strong shade of color. Two of the best known sources of light are the gas jet and electric lamp. They are to be found side by side in nearly all large buildings of recent date. In the field of gas lighting the Welsbach burner has made quite a name for itself. It is cheaper than the ordinary jet, as regards the consumption of gas. It is spoken of because the light proceeeds from an incandescent web-like mantle of a very fragile character, within which the gas and oxygen of the air combine during combustion.

In all devices depending upon the heat of a body for the production of light there is a great loss. Heat, which may be regarded as the source of such light, is radiated in large quantities as dark rays. The filament or body that gives light is the medium upon which the heat plays, producing illumination, but at the expense of from ten to thirty times its equivalent in heat. Incandescent filaments, gas flames, or, in fact, any means of producing light from heat in the final transformation, is of low efficiency, and therefore but a temporary method. The latest developments of the day point to an entirely different principle, upon which hang all our hopes of future improvement.

Acetylene gas has of late been tried with considerable success as a light giver. Its manufacture depends upon the reduction of lime and carbon in an electric furnace, the product, calcium carbide, producing acetylene gas in abundance when thrown into water. A white and intensely brilliant flame is given off by it when burnt. The danger of explosions, the cost of manufacture, and the risk of leaving it to the inexperienced hands of a household, have for the present deprived us of its use. The ordinary illuminating gas is vastly improved by the addition of a small percentage of acetylene.

The measurement of light is carried on by means of the photometer. The principle upon which it works is simple in character as well as application. If light strikes a flat surface, it is lit up with a certain intensity. The further away the light is removed the fainter becomes the illumination. This reduction or increase of light follows a certain law. The intensity of the light upon the flat surface varies inversely as the square of the distance between it and the illuminant. Taking an example for illustration, we have as follows:

100 C. P. lamp, one foot from a screen, by varying the distance, the intensity of light on the screen becomes—

At 2 feet, 25 C. P.
At 3 feet, 11 1-9 C. P.
At 4 feet, $6\frac{1}{4}$ C. P.

Measurements of candle-power thus require the use of a standard light and a variable distance.

"Jumbo" dynamos heated seriously, and the commutators sparked viciously under full load, and it was necessary to use an air blast to keep the temperature down.

The station "bus" bars were built up of the half-round copper bars of the Edison two-wire tubes, and the main dynamo switches—ponderous affairs, as big as hay-cutters—established connection between the dynamos and the "bus."

The underground system of mains and feeders—then of the two-wire system—had a length of about 18 miles.

The Edison underground tubes for the two-wire system differed from the present type in having two conductors of nearly semi-circular section, instead of the three copper rods used in the three-wire system, and were separated by paraffined cardboard disks, instead of spirally-wound jute rope before filling with compound. The coupling joints of the 20-foot lengths were made of solid copper loops instead of stranded cable. At the time of laying the underground system many of the tubes of large and small conductor section were bent by a special machine to the angle necessary to overcome the obstacles encountered in the streets, instead of using angle boxes, and many of the faults that developed in the early days were due to contacts in these bends.—John W. Lieb, Jr., in "Cassier's Magazine."

EVOLUTION OF INTERIOR CONDUITS FROM THE ELECTRICAL STANDPOINT.

By Luther Stieringer, M. I. E. E.

(Concluded from page 385.)

The runs were not long, and the bends, or sweeps, were therefore easily placed, and could be concealed without difficulty. Ordinary, flexible cords were inserted as conductors, giving satisfactory results. This tube not having been closed at its terminals, permitted circulation of air and developed moisture, which, however, did no harm.

About this time a twin conductor was evolved, based on comparatively no insulation. This twin conductor was patented. The copper conductors were separately covered with a thin cotton covering, without any high insulation. These were laid side by side, and both were covered with additional insulation.

The object in closely associating these two conductors in this way was to assure the blowing of a fuse in case of a leak or short circuit. The proximity of the conductors would produce a low resistance arc, the rush of current at that point resulting in the rupture of the fuse. This method was subsequently put into commercial practice, but had to be abandoned, as it developed more faults than the evil it sought to correct, and largely assisted in establishing the use of highly insulated conductors in conduits and raceways in interior installations.

Shortly after the Greenwich installation, a paper tube, impregnated with bituminous compound, was produced. A considerable quantity of this tube was marketed before it was found that, if concealed in plaster or cement, it failed to resist chemical action that ultimately destroyed it.

To overcome this, the paper tube was covered with a thin brass sheathing or covering. This, while to some extent resisting chemical action arising from proximity to plaster or cement, was, nevertheless, susceptible to mechanical injury.

During the time that this brass tube was being developed and marketed, the value of an interior conduit system as a means of readily inserting and withdrawing a conductor, was fully recognized by engineers and constructors.

A paper was read before the meeting of the National Electric Light Association at Detroit, in September, 1886, entitled, "Some Features of Incandescent Lighting and Wiring." In this paper the advantages of a system of distribution and control versus circulation, were fully recognized. Distribution of current in buildings became more systematized through the adoption of a system of distribution and control. (See Appendix.)

The distribution and control system was first brought into comprehensive use in the St. Louis Exposition Building, in 1885, in a permanent plant of over 5,000 lights, in which all the circuits were derived from points of distribution, there being some 20 or more distributing points arranged in the building, with over 400 or 500 local circuits.

Had the system thus introduced at that exposition been in general use, as it is now in the best practices, conduits would long ago have been extended in the iron, steel or other metal form, from the fixture back to the source of supply, thus filling the gap between the two points, and preventing any disturbance or injury to conductors placed within them.

In the construction of buildings, various artisans must in turn complete their work. The gas piper, the plumber and steam fitter, each has his operations so arranged that he can practically complete the work before the plastering, woodwork and general finish has even been commenced.

The use of the conduit likewise permits in branch lines, such as are confined to rooms, the placing of the electrical material in advance of the plasterer or trimmer, if such conduiting be properly arranged between distributing points to which the mains are brought.

At the World's Fair, in 1892, the question came up as to the protection of the conductors, some of which were carrying 2,000 volts alternating current within the buildings. As these conductors in many cases had to be placed under the floors, it became a very important matter to secure them against injury.

In considering various methods of protection, all forms of manufactured insulated tubes then on the market, including various kinds of mouldings, were rejected, as not affording that freedom from the damage that nails, chisels, and other casual or malicious interference might cause.

As a result, the Chief of Construction authorized the use of plain iron pipe, relying entirely on the sufficiency of the insulation of the conductors therein placed. The large amount of bare iron pipe so used gave absolutely satisfactory service.

The results of this experiment proved conclusively to the various engineers and constructors attached to the electrical work of the Columbian World's Fair the value and sufficiency of the protection afforded by bare iron pipe, since which time they have one and all been firm advocates of its use for conduit purposes.

In 1889, at the retail store of A. T. Stewart, Broadway and Tenth street, New York City, there were installed over 3,000 lamps. All the primary feeders connecting the various converters were placed in gas pipes. The pipes were laid on the iron ledges of the building. Although these pipes and wires of a total length of about two miles were placed by inexperienced men, they were in constant and successful use for over five years, conveying satisfactorily a current of 15 amperes and 1,000 volts, or 200 horse-power, although constantly exposed to the weather. In the subsequent installation of an isolated plant the above mentioned conductors were again used. In New York and elsewhere, thousands and thousands of feet of plain iron pipe have been in use for many years with high-pressure currents operated in them; and there is probably more non-insulated iron pipe in use to-day, much of which was installed many years ago, than in all other forms of insulated conduits so far placed.

To further illustrate the foregoing facts, it may be said that there are about 30,000,000 incandescent lamps in use to-day. Assuming that there are but six inches of pipe to each lamp fixture, we have a total of 15,000,000 feet, or several thousand miles of non-insulated iron or brass pipe in use in fixtures alone; no insulation of the same, other than that furnished with the conductors, having been found necessary.

The best experience of the past 15 years in interior wiring has demonstrated the following facts:

1. Indiscriminate wiring with staples is universally condemned.

2. Cleat wiring is admissible in exposed work where the circumstances admit, but not in any concealed work.

3. Wires imbedded in plaster, depending on the insulation only for protection, are condemned.

4. Lead-covered wires are also condemned except where protected in a conduit.

5. Wires in mouldings do not afford mechanical or chemical protection, and are only admissible in surface work.

6. Wires carried in plaster and covered with split or zinc tubes to prevent injury by trowels, are condemned.

7. Glass or porcelain insulators can only be utilized in special cases of exposed work.

8. Paper tubes do not afford absolute mechanical and chemical protection.

9. Insulated tubes covered with a thin coating of brass or other metals, do not afford absolute mechanical and chemical protection, but, in exposed work, they are, to a certain extent, admissible.

10. Woven fabric conduit does not afford absolute chemical and mechanical protection.

11. Heavy insulating covering, integral with the insulation, offers no absolute protection against mechanical

and chemical injury, and is analogous to rubber tubing for gas distribution installed throughout a building.

12. Concentric wiring is practiced in England with satisfactory results, but is not in use in the United States. It offers many possibilities in the direction of a solid and fixed system.

13. Paper-lined iron or steel pipes, known as "Iron-Armored Conduit," "Builders' Tube," "Armorite," "Clifton," and plain iron or steel pipe, are the only conduits that can afford absolute security against mechanical and chemical injury and assure permanence.

(*To be Continued.*)

ELECTRIC WELDING WITH AN ORDINARY LIGHTING CURRENT.

A short time ago experiments were carried out at the Deptford Works of the London (England) Electric Supply Corporation by the Electric Welding Company to ascertain if an ordinary lighting current could be used for electric welding. Hitherto this process has been carried out by a specially generated current. But the advantage of being able to use the ordinary current is obvious—it would especially suit the generating companies which have little work to do in the day time. The "Engineer" describes the apparatus as follows: It consists, 1, of a generator of alternating current; 2, a welding transformer provided with clamps and mechanical appliances to work the heated metal; and, 3, an electrical regulating apparatus, which is used to control the heat in the metal to be welded, this regulation being effected by varying the intensity of the generator fired.

The transformer consists of a cylindrical core made of stampings of charcoal iron. On this core is wound the primary of the transformer. The secondary consists of one turn of massive copper. In the 40 kilowatt type this secondary has an area of about 27 square inches. The ends of the secondary are brought close together, but are insulated one from the other by an insulating disk. The movable clamps into which the article to be welded is fixed slide on these two ends of the secondary. The maximum working electromotive force of the primary is 300 volts, and the ratio of turns of primary to secondary is about 300 to 1, consequently the electromotive force is very low. The usual method of working larger transformers is to have a separately excited generator, in the field circuit of which an adjustable rheostat is fixed. This rheostat is controlled by the smith at the welder, and as the sole technical knowledge necessary for increasing or decreasing the heat is confined to the turning of a handle to the right or left, it will be seen that a smith without previous electrical knowledge can, with a few days' practice, completely master the working of this method of welding.

A 40-kilowatt welder, such as was used in these experiments, occupies a floor space of 55x34 inches, and weighs 2,800 pounds. The welding capacity—cross sections—in square inches, is: Iron and steel, 3.1; brass, 1.8; copper, 0.79. The demand for rubber tires for all classes of carriages has brought into use tires of difficult section. For welding in the ordinary manner such sections, however, are admirably adapted for electric welding on the Thomson process.

During the last few months the Electric Welding Company have welded commercially at their works a large quantity of tires of widely varying shapes and difficult sections. They have also been able to weld electrically parts on to gun actions having on them valuable work which would otherwise be thrown away.

Another interesting piece of work which has been done recently was the welding of a new piece of armature shafting on to an armature which was already wound. This was done without damaging the windings by heat. The experiment made at Deptford was with a view to finding out if current could be taken from the supply station mains and used for welding purposes. It was found that welding in this way could be successfully carried out. The experiments were altogether successful, the 5,000-volt alternating current supplied by the Ferranti dynamos being let down to 300 volts by a transformer, and supplied at that tension to the welder, when it was again let down to something less than 1 volt. A high power is required on large sections, but only for a very short time.—Iron Age.

THE WORLD MOVING BACKWARD.

Lord Kelvin (Sir William Thomson), one of the greatest living authorities in physical science, stated not long ago that the physical processes of nature are all reversible, and that as all of them, no matter how complex they might appear to the human senses, consist in reality in the motions of invisible molecules, if some power could all at once cause each molecule to move in exactly the opposite direction with the same velocity that it possessed at the moment, all the world would begin and continue to move backward; waterfalls would flow up the sides of cilffs; rivers would run upward from the sea; rain would rise; full-blown flowers would shrink into buds, and plants dwindle into seedlings; man himself would become young again, passing from old age to infancy. This topsy-turvy sort of a world will, of course, never be realized, but we may behold an exact picture of it by simply running the kinetoscope backward. Some of the wonderful things thus observed were described recently in a lecture before the French Academy of Sciences by Prof. G. Queroult. They are thus set forth in a notice, which we quote from the St. Louis Globe-Democrat:

"During some of his experiments he hit upon the idea to turn around photographic records and also the series of pictures seen through the kinetoscope. Having photographed a plant at regular intervals and shown in the kinetoscope the growth, the development of the stem, leaves, buds, flowers and fruit, the same consequence of photographic pictures reversed was presented to the eye of the astonished academicians, who wondered at the fruit turning into flowers, flowers into buds, buds drawing back into themselves and disappearing, the leaves closing, getting smaller and disappearing, the stem getting shorter and shorter, until the earth closes over it.

"The most incredible things are developed before the eyes of the spectator, if a most ordinary series of such pictures is reversed. A drinker takes up an empty glass and replaces it full upon the table; a smoker sees the stump of a cigar flying at him from the floor, takes it to his mouth and sees the smoke originate in the room, draws it into his mouth and into his cigar, which is gradually lengthened and finally replaced in the pocket. A wrestler, who has probably thrown away his garments, is recovered with them by their, so-to-speak, walking up on him into their places, while himself performs motions of which we can understand nothing, because we never saw these most ordinary motions performed backward; a man, for instance, seated at a table before an empty plate works hard taking bite after bite from his mouth, until the chicken is whole again on the dish before him, and the side-dishes are also returned full to their respective places. In order to fully enjoy an exhibition of the kinetoscope, such an exhibition should be completed by arranging alongside of each other the same scenes in regular order in one machine and reversed in another. It would be advisable, however, to inform the spectators previous to their looking at such a reversed series of pictures, for otherwise they might think themselves the victim of a dream, a hallucination, or something worse."—Literary Digest.

Prescott, the capital of Arizona, boasts that it is the nearest approach to the New Jerusalem, as described in the Bible, as its streets are being paved with gold. The granite used for pavements contains $4 in gold and 20 cents in silver to every ton, so that in time, when less expensive methods of reducing ores are used, it may pay the city to tear up and crush its street pavements.—National Recorder.

COMPRESSED AIR FOR NEW YORK STREET RAILWAY.

The Metropolitan Traction Company, which controls altogether about 132 miles of street railway in New York City, and carries daily upward of 650,000 passengers, is contemplating an important change in the motive power of a large portion of its lines. About 32 miles of the system are at present operated as cable and underground trolley lines, and the plant is of the latest pattern and thoroughly up-to-date, but the greater part—fully 100 miles of the lines—is still worked by the slow and objectionable horse car. Several months ago the company determined to abolish the horse car and introduce in its place some form of mechanical traction, and in the interval their agents have been making an exhaustive examination of the many systems of street-car traction which are being operated in Europe and America.

It has been determined to make a thorough trial of a compressed-air motor. We are informed by the Metropolitan Company that at a private trial recently had at the Worcester works before the engineers and officials, the Hoadley motor showed a remarkable efficiency, as compared with any compressed-air motor which they had previously subjected to trial. At present ten of the company's cars are being equipped with the new motor, and if they prove as successful in service as the experimental car which was recently tested, it is likely that all the existing horse car roads will be similarly equipped.

The air will be carried in two cylindrical steel tanks placed between the trucks and beneath the floor of the car, and they will be charged at an initial pressure of 2,000 pounds to the square inch. The power house at 147th street and Lenox avenue will contain a 500-horse power Greene-Wheelock engine and a Minerva air compressor, the reservoir capacity of the plant being 5,000 cubic feet. The compressed-air motor is being adopted in preference to trolley or cable traction, not merely from motives of economy, but also with a view to securing a service which shall be free from the interruptions to which the cable and trolley systems are liable.

The operation of these cars will be watched with close attention, not merely by the company which is making the experiment, but also by the engineering world at large. Engineers in the United States have been so fully occupied with the development of electric traction —and it has had a growth and a success which is phenomenal—that comparatively little attention has been paid to other methods of traction which utilize the oil, gas and compressed-air motor. As compared with the cost of the electric and cable systems, says the "Scientific American," the compressed-air and gas motors which are being increasingly used in European cities are said to be showing remarkably economical results.—Progress of the World.

THE VETTER CURRENT TAP.

This simple device will be found useful wherever the incandescent electric current is employed for lighting purposes, as it is designed to facilitate the transmission of the light or power of the current to any desired point in the vicinity of the fixture, and thus virtually doubles its capacity. As the name indicates, it "taps" the current, and does it in so simple a manner that a novice can use it without the slightest difficulty.

In every office, factory or home, wherever the electric current is in use, the Vetter current tap will be found a great comfort and convenience. An illustration of this current tap can be seen on another page. It is manufactured by J. C. Vetter & Co., No. 104 East 23d street, New York.

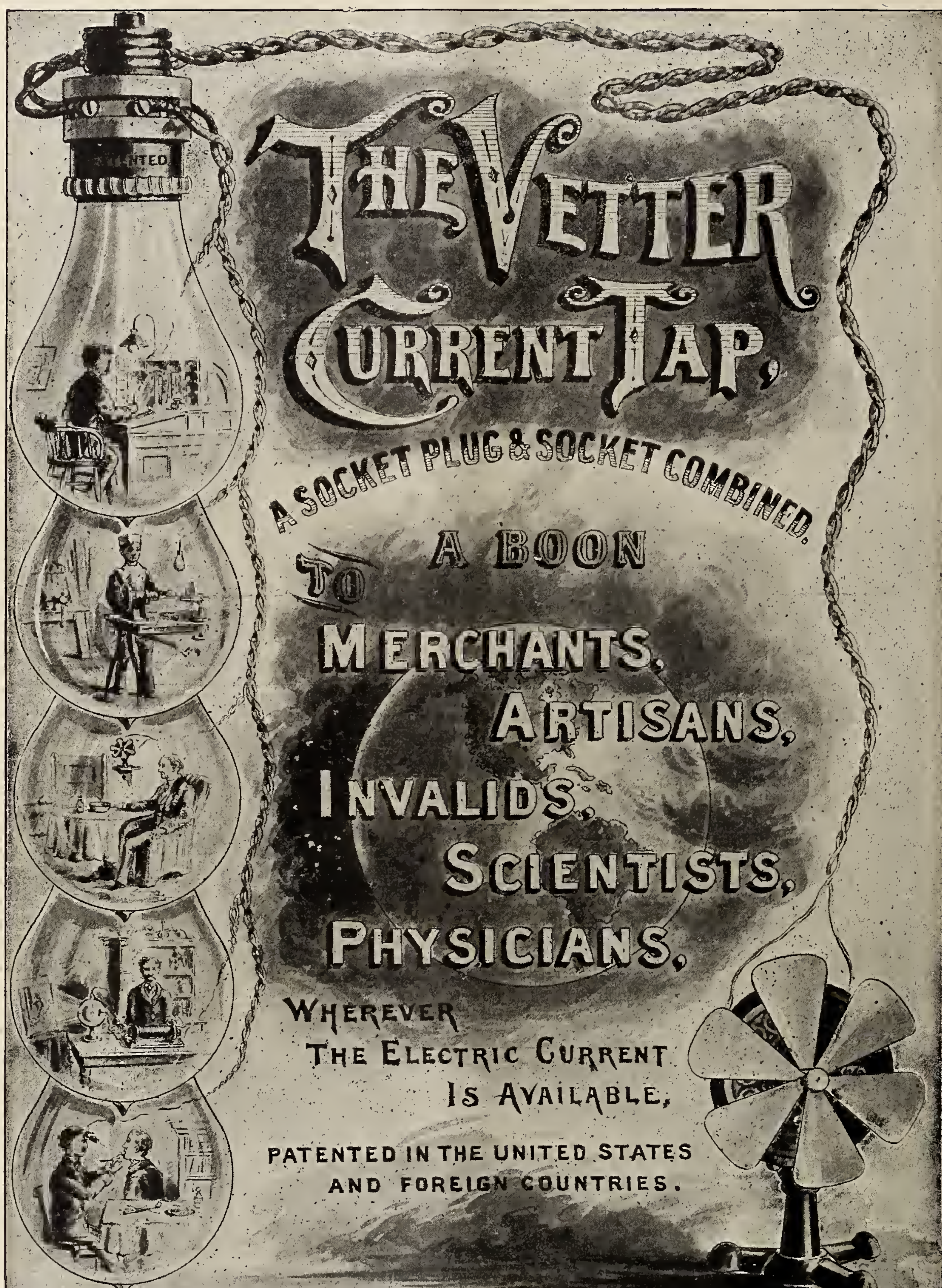
Baraboo, Wis.—Arrangements have been completed to build a telephone line between Baraboo and Reedsburg.

ATMOSPHERIC ELECTRICITY.

Professor A. Schuster lectured recently at the Royal Institution of Great Britain upon "Atmospheric Electricity." When this science was but in its infancy, it was noticed how the spark of a battery resembled thunder and lightning, and the idea soon became generally, although somewhat vaguely, accepted that a flash of lightning was only a form of electrical spark, while it was left for Franklin, who had long suspected that a thunder cloud was charged with electricity, to establish by experiment a complete parallelism between lightning and electricity. This he successfully accomplished in the year 1752, and on his researches are based the complete understanding we now have as to the various phenomena of atmospheric electricity, After briefly alluding to Franklin's and Faraday's work in connection with the subject, the question of the origin of the "lines of force" was discussed, and Professor Schuster passed on to consider the various causes of de-electrification which are constantly going on. Important factors are fires; these discharge electricity constantly, and it was pointed out incidentally that factory chimneys themselves act as good conductors of electricity, better even than the lightning-rod which is fixed to the summit. Having pointed out that the theory sometimes put forward as to the disappearance of the "lines of force" by passing away from the air into space was untenable, the professor showed that on rising in the air the "lines of force" at first increase, but in altitudes of 15,000 to 20,000 feet they end. Their disappearance, however, depends upon the condition of the atmosphere, as in very fine weather they end at 12,000 feet. The fact that electrical effect in the atmosphere is dependent upon the moisture present is well established, but some observers have had an idea that it is influenced by solar radiation instead, and an instance was cited which showed that electrical effect in Germany was directly connected with a dust storm which occurred in Alexandria, the electrification not being shown before the storm.

In discussing the effect of lightning upon trees, statistics showed that 48 oak trees are struck to one beech tree, the ratio being dependent upon the amount of oily matter contained. Some curious effects of lightning having been described, a series of photographs were shown illustrative of various types of flashes, and after briefly alluding to silent discharges, the professor described the phenomenon known as St. Elmo's fire. This name is derived from St. Erasmus, who was the patron saint of the Italian sailors. Its peculiarity is that it appears as either positive or negative, one condition being as probable as the other. The phenomenon is simply one of induction. The various hypotheses which have been advanced to account for atmospheric electricity were briefly noted. Their name seems to be legion, as they number since 1753 more than a score, while the year 1884 alone produced five new theories! Of this number the rotation of the earth, direct radiation, heat and evaporation may be mentioned, and an instance was given where, from personal observation, electrical effect was shown to be due to the actual formation of cloud. Speaking of the aurora borealis, it was mentioned that it seems to be connected with cirrus clouds at low altitudes, and that the many spots in the sun have been sometimes attributed to the existence of many auroras. The lecture was profusely illustrated by experiments, all of which passed off without a hitch.

The entire business and plant of the Capo-Farad Battery and Appliance Works, of No. 27 Thames street, New York, has recently been purchased by Mr. Arthur J. Farnsworth, of Mamaroneck, New York. Mr. Farnsworth, it is understood, intends to enlarge its scope and usefulness in the electrical field in the future by undertaking, in addition to the manufacture of the well-known Capo-Farad battery, all kinds of model and repair work and battery apparatus.



THE VETTER CURRENT TAP,
A SOCKET PLUG & SOCKET COMBINED.
A BOON TO
MERCHANTS,
ARTISANS,
INVALIDS,
SCIENTISTS,
PHYSICIANS,
WHEREVER THE ELECTRIC CURRENT IS AVAILABLE,
PATENTED IN THE UNITED STATES AND FOREIGN COUNTRIES.

THE RIKER FAN MOTOR.

The Riker Motor Company has placed an excellent new fan on the market. It is a decided improvement over last year's, having three speeds, being ironclad and running noiselessly. The Riker fan is also nicely finished, strongly made mechanically, and easily taken apart. Mr. Riker is well known as the designer of some fine machinery, and in all cases where he has turned his attention upon any department of electricity, progress becomes at once evident. The splendid shop equipment and deep-seated experience of Mr. Riker have enabled him to produce a fan-motor of undoubted merit. They are manufactured at Nos. 45-47 York street, Brooklyn, N. Y.

X RAY SUPPLIES.

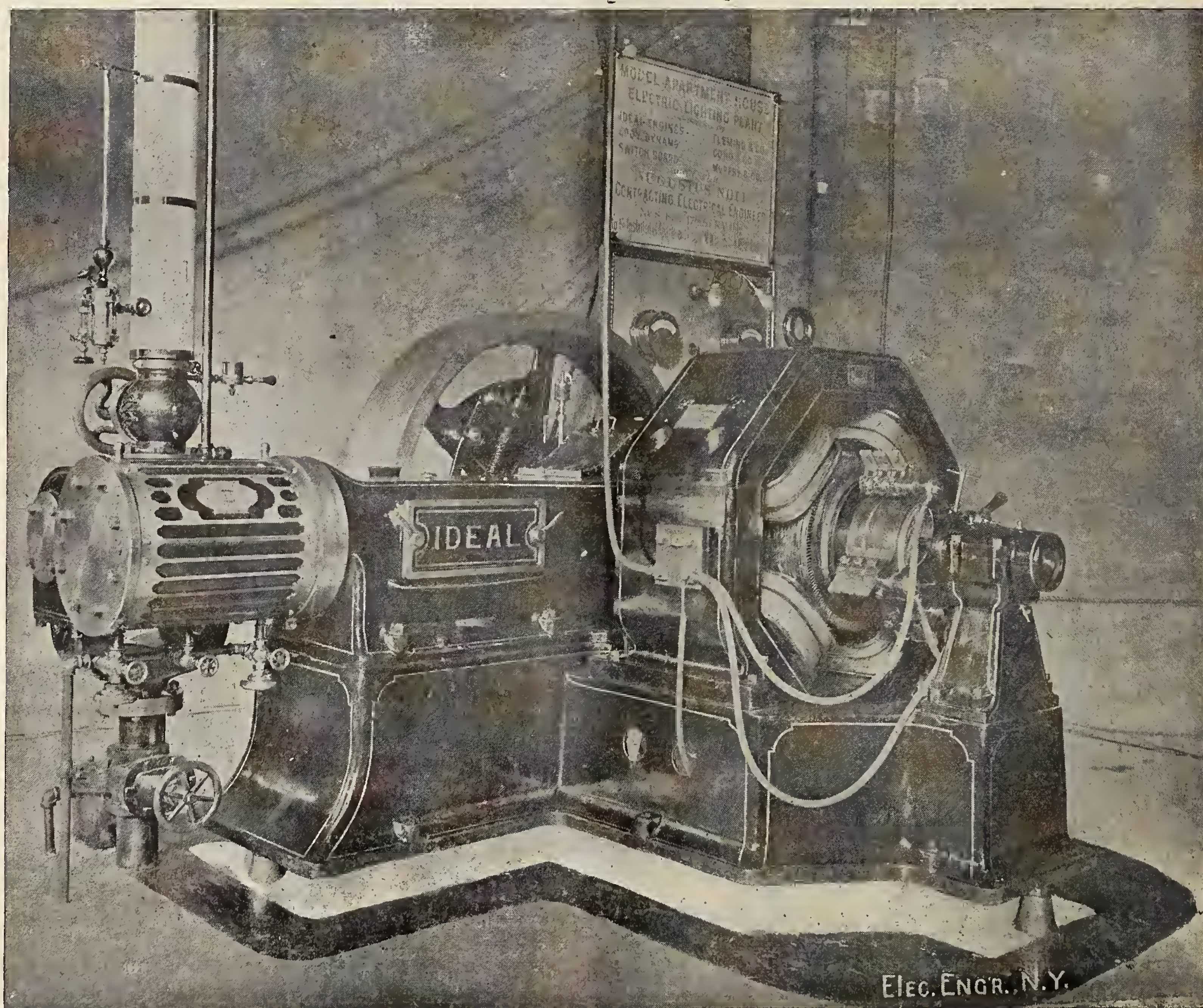
C. C. Sibley & Co., of Fourth avenue, between 24th and 25th streets, New York, the well-known dealers in electric light, power and general supplies, are at present manufacturing a full line of X ray apparatus. They make excellent fluoroscopes, induction coils and battery outfits.

Tungstate of calcium, for fluoroscopes, is manufactured by themselves, and also supplied to Edison and others making fluorescent screens.

AN IDEAL ENGINE AND EDDY DYNAMO.

If an engineer cared to see a plant that is without doubt unexcelled in the department of private installations, let him call at the Haas Apartment House, Ninety-first street and West End avenue. A plant has been installed there, consisting of an Ideal engine and an Eddy multipolar dynamo. The first time the writer saw a plant of this kind at the Electrical Exposition he was greatly surprised. The reasons may be enumerated, but the most striking characteristic was due to the fact that, although engine and dynamo were supported on three pins and direct-connected, hardly a tremor was perceptible throughout.

The dynamo is of admirable design and construction. It can run faultlessly at overload or full load, and not even the most experienced could tell offhand the amount of work it was doing. What is true of the dynamo is also reflected in the engine. In a plant like this, direct-connected and laboring under a heavy strain, the weaknesses are apt to demonstrate themselves without delay. But if none appear, and only the soft whirr and faint hiss are audible, then we may safely conclude that perfection has been so closely attained that external changes have no visible sign of their presence.



PLANT INSTALLED IN HASS APARTMENT HOUSE.

"In the occasion of its millennial celebration, the University of Buda-Pesth will confer an honorary degree upon Dr. John S. Billings. It is said that degrees will not be conferred on any other Americans and only on four Englishmen: Lord Kelvin, Mr. Herbert Spencer, Prof. Max Muller, and Mr. James Bryce."—Progress of the World.

The regulation of the engine and dynamo accounts for this. Perfect equilibrium and a most perfect proportioning of part to part has accomplished this end. The freedom from vibration is something marvellous and decidedly impressive. The generator is 50 K. W., and its speed 280 revolutions per minute. Coho & Co. and Fleming & Co., of No. 203 Broadway, work in combina-

tion on these plants, supplying respectively dynamo and engine. By calling on them you will receive every courtesy and a long list of valuable references, which they have received unsolicited.

Possible Contracts.

New Castle, Pa.—The Elliott-Washington Steel Co. will soon begin the erection of its new plant.

Greenville, Pa.—The Lozier Tube Co. will erect large tube works in which to install entirely new machinery.

Cleveland, O.—Negotiations will shortly be concluded for the erection of a ten-story office building on the southeast corner of Ontario streeet and the Public Square. The building is to cost not less than $100,000 and will be erected by a stock company. Address James T. McAninch.

Grand Rapids, Mich.—A franchise for the establishment of an electric light plant in Otsego has been granted to J. Boekholt and J. W. Arnold. The work on the new plant will be begun at once.

New Haven, Conn.—Work was begun on the new Manufacturers' Street Railway. The company has purchased the electric locomotive shown by the General Electric Co. at the World's Fair. The cost of the new road is expected to be between $25,000 and $30,000.

Milwaukee, Wis.—An ordinance has been introduced in the Common Council for the issue of $100,000 bonds for the purpose of erecting a municipal electric lighting plant.

Chicago, Ill.—The Chicago City Railway Co. will shortly erect a new power house at a cost of $125,000. This power house is to furnish the power for the new lines which are now being constructed.

Philadelphia, Pa.—Permits have been granted to the Edison Electric Light Co. to lay conduits on Market street, and to the Bell Telephone Co. on Ridge avenue.

Baltimore, Md.—Proposals will be received at the office of the Lighthouse Engineer until 12 o'clock July 30 for furnishing the material and labor of all kinds necessary for the erection and delivery of the Smith Point Light Station, Virginia. Plans, specifications, forms of proposal and other information may be obtained on application to this office. E. H. Ruffner, Major of Engineers, U. S. A., Lighthouse Engineer, Fifth District.

McLeansboro, Ill.—The city of McLeansboro will receive bids for the erection and establishment of an electric lighting plant to be established in said city. Bids will be in writing and will be received at the City Clerk's office August 1. Plans and specifications on file. C. C. Wright, City Clerk.

Brooklyn, N. Y.—The Pratt Institute is to have a building for a new school, to cost $11,000, at Grand and De Kalb avenues.

Hartford, Conn.—Philadelphia capitalists are interested in a scheme to build an electric road between Hartford and Springfield. The route proposed is by way of Agawan and Suffield.

York, Pa.—At a meeting of the Consistory of Heidelberg Reformed Church it was decided, among other things, to have the church wired and lighted by electricity.

New Corporations.

Indianapolis, Ind.—The Faradizer Co. has been incorporated by T. D. Bottome, C. C. Hartman and J. G. Hamilton, with a capital stock of $100,000, to manufacture Roentgen ray apparatus for physicians, besides other photographic and electrical appliances.

Portland, Me.—The Electric Spinning Mule Co. has been organized at Portland, capital stock $500,000, to manufacture and deal in spinning, weaving and carding machinery and electrical spinning mule, which is controlled by the company. Edward K. Milliken is President.

Valdosta, Ga.—The Valdosta Electric Light Co. has been reorganized. The plant will be enlarged and new machinery added. Capital stock, $20,000. S. W. Bentley, Manager.

Huntersville, W. Va.—The Pocohontas Electric Co. has been incorporated by J. S. Lang, F. C. Bartlett and H. Hirschfield, of New York; A. L. McKaye, of Brooklyn, and D. W. Cooper, of Elizabeth, N. J., capital stock $200,000, to erect electric light and power plants.

NEW TELEPHONE COMPANIES.

Ansonia, Conn.—The American Telephone Co. has been organized at Ansonia, with a capital stock of $1,000, by C. D. Warner, V. Munger and D. Bartholomew.

New York City.—The Board of Electrical Control has transferred the franchise of the Metropolitan Telegraph and Telephone Co. to its successor, the New York Telephone Co.

Watertown, N. Y.—Northern Telegraph and Telephone Co. Capital stock, $30,000. Directors—M. B. Sloat, Mount Vernon; Joseph H. McCormick, Brooklyn, and Daniel E. Wing, Hackensack, N. J.

Telephone Notes.

Fairfield, Ill.—The Wayne County Telephone Co., with principal offices at Fairfield, has bought the telephone lines belonging to the Clay County Telephone Co. Rothwell, Reagus and Smith, of the company, now own all the telephone lines in Clay County. The company is constructing and building lines to connect every post-office in Jefferson, White, Wayne, Wabash, Edwards, Richland, Marion and Clay Counties.

Nashville, Tenn.—The Southern Telephone Co. wants prices on the most improved telephones, switchboards, conduits for 3,000 wires, etc. Address J. E. Thompson, Manager.

Cleveland, O.—The Central Union Telephone Co. has petitioned the City Council for a franchise for the erection of poles in this city, with a view of putting in an exchange in opposition to the home company.

TELEPHONE PATENTS.

Issued June 16, 1896.

562,009. Telephone Switchboard. George S. Maxwell, Richmond, Va., assignor, by direct and mesne assignments, of three-tenths to William H. Cullingworth and Joseph N. Cullingworth, same place. Filed Mar. 17, 1896.

562,010. Telephone Switchboard. George S. Maxwell, Richmond, Va., assignor by direct and mesne assignments, of three-tenths to William H. Cullingworth and Joseph N. Cullingworth, same place. Filed Mar. 17, 1896.

562,011. Telephone System. George S. Maxwell, Richmond, Va., assignor, by direct and mesne assignments, of one-fifth to William H. Cullingworth and Joseph N. Cullingworth, same place. Filed Mar. 17, 1896.

562,012. Telephone Switchboard. George S. Maxwell, Richmond, Va., assignor, by direct and mesne assignments, of three-tenths to William H. Cullingworth and Joseph N. Cullingworth, same place. Filed Mar. 20, 1896.

562,013. Telephone Switch. George S. Maxwell, Richmond, Va., assignor, by direct and mesne assignments, of three-tenths to William H. Cullingworth and Joseph N. Cullingworth, same place. Filed Mar. 25, 1896.

562,064. System of Telephone Exehange. Salomon Berditschewsky (called Apostoloff), London, England, assignor to the Apostoloff Automatic Telephone Patent Syndicate, Limited, same place. Filed Mar. 23, 1896.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued June 16, 1896.

561,958. Automatic Electric Switch. William S. Barstow, Brooklyn, N. Y., and Robert Lindsay, Cleveland, O. Filed June 5, 1895.

561,970. Electric-Railway Switch. William R. Daggett, Dayton, O. Filed Nov. 30, 1895.

561,975. Electrogalvanic Belt. Alonzo Dow, Wooster, O. Filed Feb. 17, 1896.

561,977. Electrical-Energy Indicator. Thomas Duncan, Fort Wayne, Ind. Filed Nov. 11, 1895.

561,982. Electrical Pilot or Signal. Henry H. Franklin, Brooklyn, N. Y. Filed Mar. 18, 1896.

561,991. Trolley. John H. Holland and Peter F. Glazier, Indianapolis, Ind., assignors of one-third to John R. Pierson, same place. Filed Aug. 23, 1895.

562,004. Telegraphy. Edward Fitz Gerald Law, London, England. Filed Jan. 8, 1895. Patented in England, Dec. 15, 1886, No. 16,485; March 5, 1888, No. 3,359, and Jan. 11, 1889, No. 506, and in France Sept. 13, 1887, No. 185,824.

562,019. Primary Battery. Richard P. Osgood, Salem, Mass., assignor of one-third to Edgar E. Ramsdell and Osgood Ramsdell, same place. Filed Sept. 30, 1895.

562,030. Pencil for Arc Lamps. Isaiah L. Roberts, Brooklyn, N.Y., assignor to the Roberts-Brevoort Electric Company, Ltd., of New York. Filed Oct, 31. 1895.

562,034. Fire-Alarm Signal-Box. John J. Ruddick, Newton, Mass., assignor of one-half to Moses G. Crane, same place. Filed Oct. 8, 1894.

562,062. Regulating Alternating Motors. Albert H. Armstrong, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Jan. 11, 1896.

562,090. Electric-Arc Lamp. Moses S. Okun, New York, N. Y., assignor to Michael F. Burns, Brooklyn, N. Y. Filed Apr. 8, 1892. Renewed Dec. 6, 1893.

562,097. Device for Removing Insulation from Electric Wires. Adolph E. O. Rieckel, Brooklyn, N. Y. Filed Dec. 13, 1895.

562,100. Controller for Electric Cars. Elmer A. Sperry, Cleveland, O., assignor to the General Electric Company, New York. Filed Mar. 20, 1896.

562,107. Electric Rail-Bond. William H. Wiggin, Worcester, Mass. Filed Aug. 28, 1895.

562,116. Controller for Electric Motors. Emory A. Bryant, Washington, D. C. Filed Apr. 18, 1896.

562,118. Emergency Electric Brake. Benjamin F. Card, Brooklyn, N. Y., assignor of one-eighth to David Naugle, Closter, N. J. Filed Feb. 6, 1896.

562,132. Trolley for Electric Railways. Martin T. Graf, Buffalo, N. Y. Filed Jan. 14, 1896.

562,142. Electric Switch. James F. McElroy, Albany, N. Y., assignor to The Consolidated Car-Heating Company, same place. Filed Dec. 29, 1894.

562,166. Insulator. Thomas Blankinsop and Joseph W. Brown, Martin's Ferry, O. Filed Mar. 24, 1896.

562,171. Automatic Car-Fender. Charles Cogniasse and David F. Shultz, San Francisco, Cal. Filed Mar. 30, 1896.

562,179. Dynamo-Electric Machine and Electric Motor. John G. Germann and Frederick B. Downing, Erie, Pa.; said Germann assignor to said Downing. Filed Mar. 26, 1896.

562,209. Electric Distributing System. Richard R. Bowker, Brooklyn, N. Y. Filed Feb. 27, 1896.

562,216. Electric-Railway System, Etc. Carl Coerper, Cologne, Germany. Filed Apr. 4, 1896.

562,253. Automatic Block System. Judson Shoecraft, Harveyville, Kan., assignor to the Western Railway Signal Company, Topeka, Kan. Filed Aug. 8, 1895.

562,261. Testing-Joint for Electric Conductors. Benjamin L. Toquet, Westport, Conn. Filed Apr. 14, 1896.

562,288. Car Fender and Brake. Emil F. Dieterichs, Cleveland, O., assignor to Clarissa Reed Dieterichs, same place. Filed Aug. 15, 1895.

562,304. Diaphragm for Electrolytic Purposes. Martin Kiliani, Neuhausen, Switzerland; Walther Rathenau, Berlin, Germany, and Carl Suter, Neuhausen, Switzerland, assignors to the Elektrochemische Werke, Berlin, Germany. Filed Aug. 15, 1894. Patented in Germany Jan. 20, 1894, No. 78,732; in France July 13, 1894, No. 240,045; in England, Aug. 10, 1894, No. 15,276; in Hungary, Jan. 4, 1895, No. 1,861, and in Austria, May 19, 1895, No. 1,755.

562,313. Electric Arc Lamp. Oliver S. Lyford, Jr., Chicago, Ill., assignor to the Siemens & Halske Electric Company of America, same place. Filed Apr. 6, 1896.

562,318. Railway-Signal. Frank McBrien, Newark, N. J. Filed Apr. 1, 1896.

562,320. Car Fender. Richard F. Preusser, Washington, D. C., assignor of one-sixth to Henry Yost, Jr., and Frank Swanson Gibson, same place. Filed Sept. 5, 1895.

562,325. Electric Burglar-Alarm. Henry Rohrdantz, Buffalo, N. Y. Filed Jan. 30, 1896.

562,356. Trolley-Wire Switch. Sylvanus D. Cushman, Akron, O. Filed Feb. 25, 1896.

The Electrical Age.

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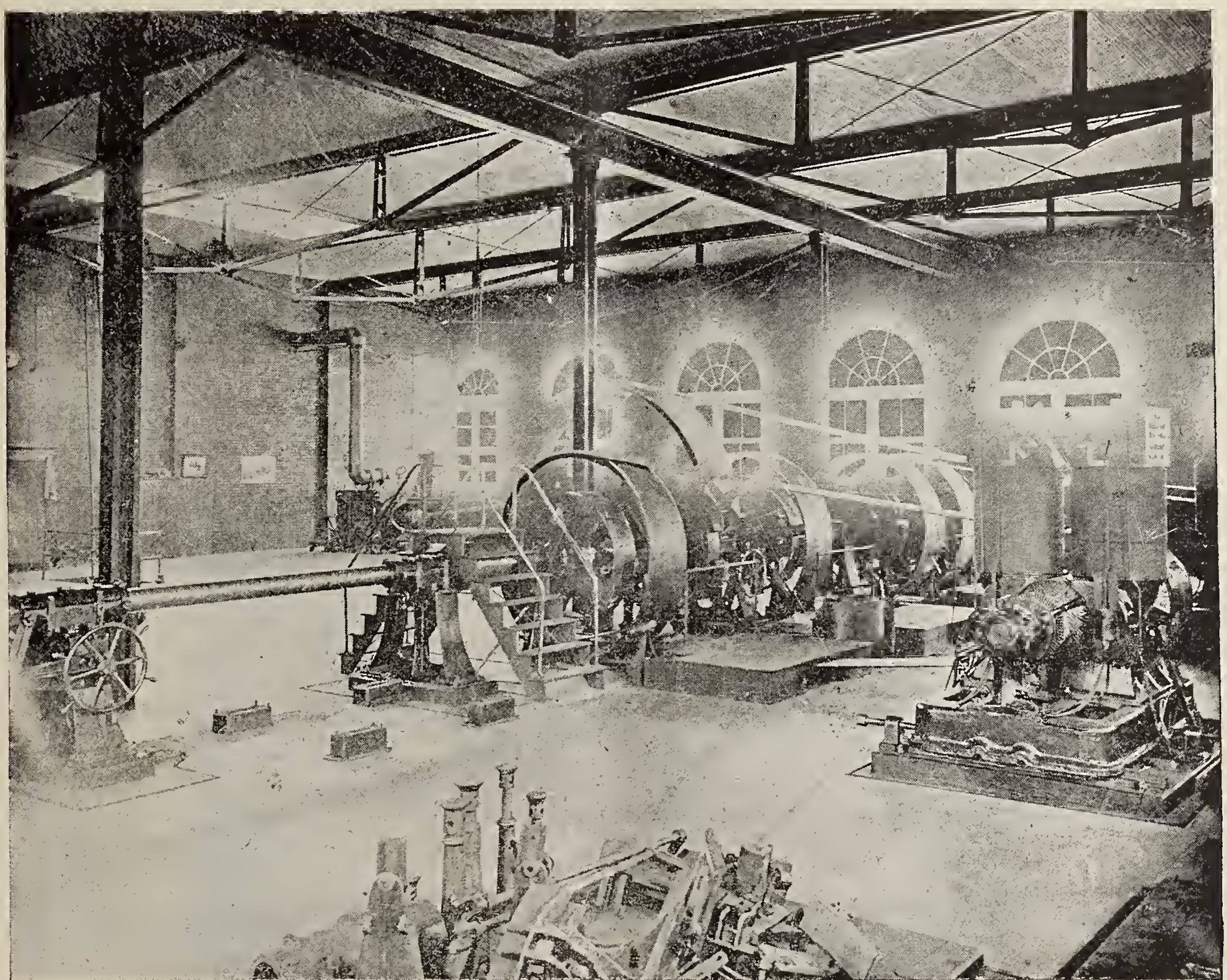


STATION FEEDING POWER CIRCUITS.

THE APPLICATION OF MOTORS.

The fields of industry in this country are very large. Apparently well developed, they are but the beginning of what will be in days to come. In one respect it may be said that America has not faltered; that is, in the development and application of the electric motor. So wonderful a change has occurred, that a stranger, having left this country for ten years, could return and gaze with greater surprise than Rip Van Winkle upon the transformation around him.

Trolley cars darting along the city tracks in place of the old shambling horse car. Cable cars with clanging bell, and within the sky scrapers of Broadway electric elevators that shoot with marvellous speed heavenward. There would undoubtedly be cause for surprise to the returned traveller, and how much more to the total stranger, overpowered by the noise, rush, bustle and general electrification of all things.

The motor, therefore, has in many respects changed the appearance of our large cities. This change is noticeable within as well as without. Certain circles of trade walled in with a moss-grown conservatism have been revived and sent to join the swelling stream of human progress.

Let us see in what respects the motor has added to the world's fund of comfort and look upon the landmarks whereon ancient structures have been built, leaving, as the teeth of time kept gnawing, but a few fragments to remind us of the past.

Familiar as the name is to some, Oersted was the father of the modern motor. It is not necessary to claim a special device in order to substantiate an idea. A principle is not assisted by the development of a new appliance because it is in itself immutable.

Faraday and Oersted can always be considered as the master minds to whom we are beholden for the dynamo and motor. The immense difference created by the fact that these two machines, although identical, still have elements of distinctiveness forced upon them because one absorbs mechanical and the other electrical energy, is surprising. The field of generation of power and electricity are separate to a striking degree.

Oersted gave issue to the principle that a coil of wire carrying a current affects a magnetic needle. From electrical we obtain mechanical energy. This is the vital principle of the motor. A powerful field of magnetism, a coil able to revolve carrying a current. The details are small in comparison. Continued revolution is obtained by the use of a commutator which, like the slide valve of

an engine, lets the current in at the time when it will assist the general motion.

Davenport has been considered the original inventor of the electric car. Some crude models still in existence exemplify the valuable principle—merely the application of a motor to a small wheeled toy. The trolley car is built of large size and has an improved motor, but it is essentially the same. Fulton's name is great because he applied a steam-engine to the propulsion of boats. Has Davenport differed one whit in general from Stephenson except in the nature of the power he used? Thus it has been the use of a motor on wheels that has opened up so vast a field of electrical engineering. In distant Russia, years ago, Jacobi took a small boat and equipped it with a motor and primary batteries. The first electric launch was then tried; it proved in its way a success. Thousands have been built since then, and although today none cross the ocean, it is not a wild fancy which prompts the engineer to expect with confidence ocean greyhounds within whose entrails the shrill hiss of a mighty motor is heard, the huge screw rotating with it hand in hand.

MECHANISM OF ELECTRIC ELEVATOR.

Marine engineers depend upon us for their futures. The work of Jacobi, Reckenzaun, Riker and Chamberlain will bear fruit on a larger scale.

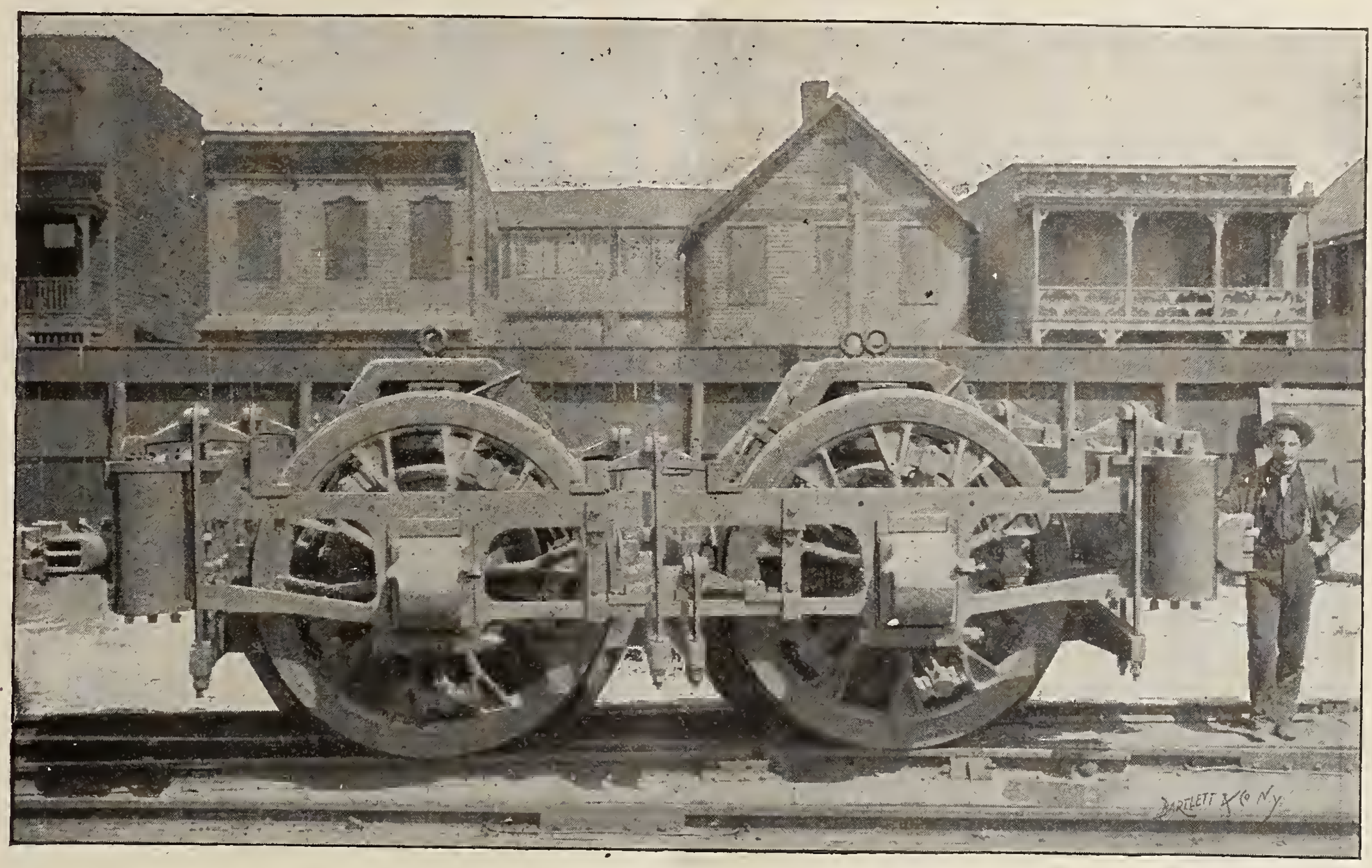
The applications of the motor summed up in a comprehensive list are not so very numerous. Applied as they are to.

Railroads,
Factories,
Vessels,
Surgery,

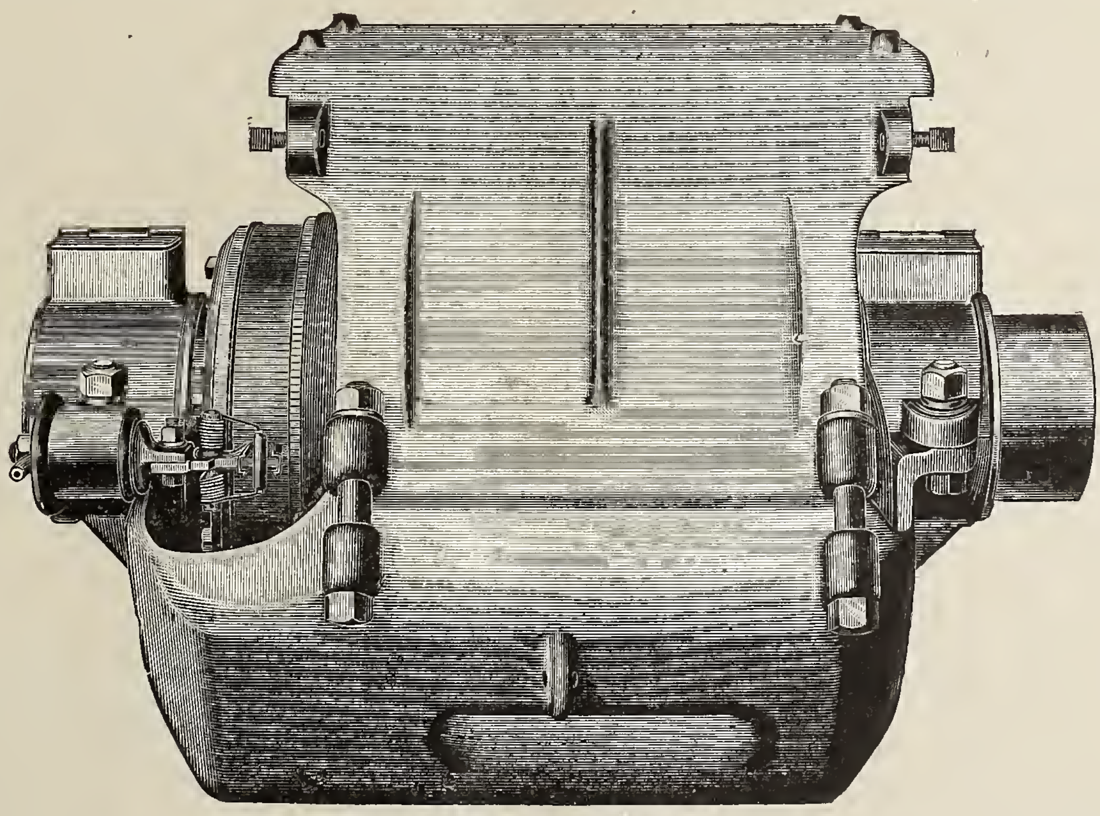
their use seems limited at present. It is in our own homes the motor lacks its best applications. The hospital has frequently applied the electric saw to the bony structures. For amputations it is unsurpassed, and to the enterprising dentist a valuable innovation. The motor has drawn its own future in many fields. In those places where cleanliness is a necessity it has no competitor. In France the linen is picked from fields in which it lies bleaching and placed upon a small motor truck. The farmer is beginning to see in the motor a means of ploughing his farm with precision and economy. The few experiments made in this manner have proved a suc-

cess, and no delays other than those attending the introduction of any new article oppose its immediate use.

The field of mining engineering, with all its rough handling of machinery, has taken to the motor without delay. It requires no air and no steam—a few hastily strung wires gives them power at any point, and with its excellent features of ready application and economy, it has no rival. Thus in this slight review the motor as a device for transforming electrical into mechanical energy is slowly but surely supplanting all other devices. The commerce carried on in the motor has just begun; it is only the sturdy manufacturer that can stand the siege of these present times that will come in for the rich harvest so near at hand.



MOTOR CONNECTED FOR TRACTION TO TRUCK.



BEFORE PLACED IN CAR TRUCK.

Mr. William C. Armstrong, the well-known salesman of arc lamps for incandescent circuits, is now representing the Electric Arc Light Co., Nos. 687-689 Broadway, New York.

Production of Glue.—It is estimated, says "Woodworker," that the annual production of glue in the United States is about 60,000,000 pounds, nearly all of which is consumed here, but from present indications the yield this year will be much less than that quantity. A prominent authority on the subject expresses the belief that from now until the first of November, when the factories again actively resume business, not less than 40,000,000 pounds of glue will be required by the consumers in the United States, against which he estimates that less than 30,000,000 pounds will be produced. The same conditions that confront the glue industry here are likewise existing, in a modified degree, in Europe, where prices are hardening, just as they are in our markets; though on the other side, up to this time, the resources of manufacturers have enabled them to fill all orders with comparative ease.

Washington, D. C.—The Bliss School of Electricity has been incorporated with a capital stock of $5,000. L. D. Bliss president.

AN ANALYSIS OF TRANSFORMER CURVES.*

A PAPER PRESENTED AT THE 13TH GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MAY 20TH, 1896.

By Charles K. Huguet.

One of the most noteworthy features of Professor Ryan's famous paper on "Transformers,"[1] before this Institute, was the distortion of the primary current curve on open secondary. This distortion, Professor Ryan ascribed to hysteresis, and this opinion seems to have been tion as a simple resistance. However, he simply expressed this theory mathematically, without giving any experimental verification, and it is doubtless for this reason that the results of his paper have not been accepted in their entirety. This apparent conflict of opinion seemed to warrant further investigation, and it was the object of experiments conducted by the writer at Tulane University in June, 1895, to throw light on this question by analyzing the current curve into its various components.

The low-tension coil of a 40-light Fort Wayne transformer was used as primary, and a run made at 100 volts and 140 ~ The method employed in the measurement

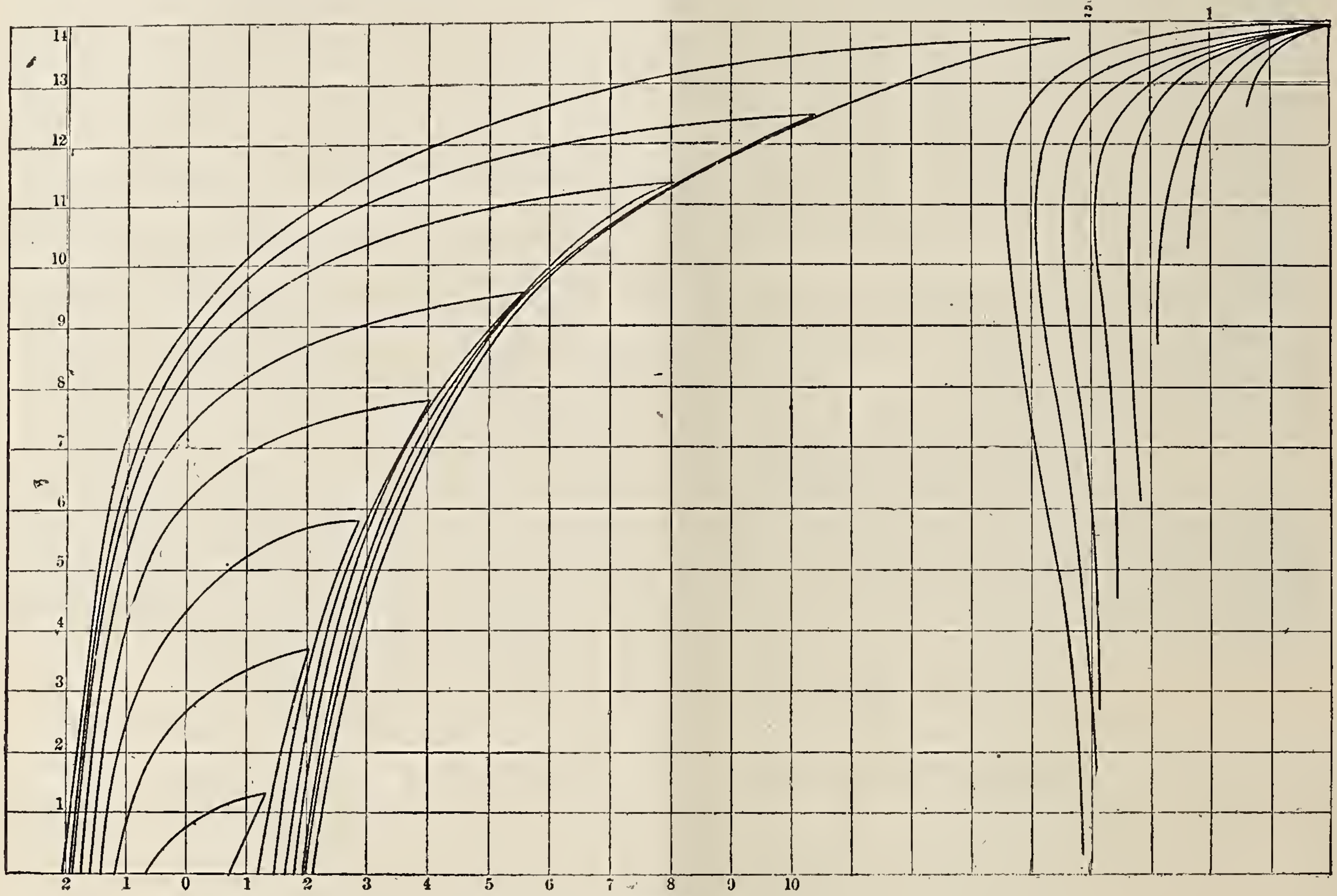


FIG. 3.

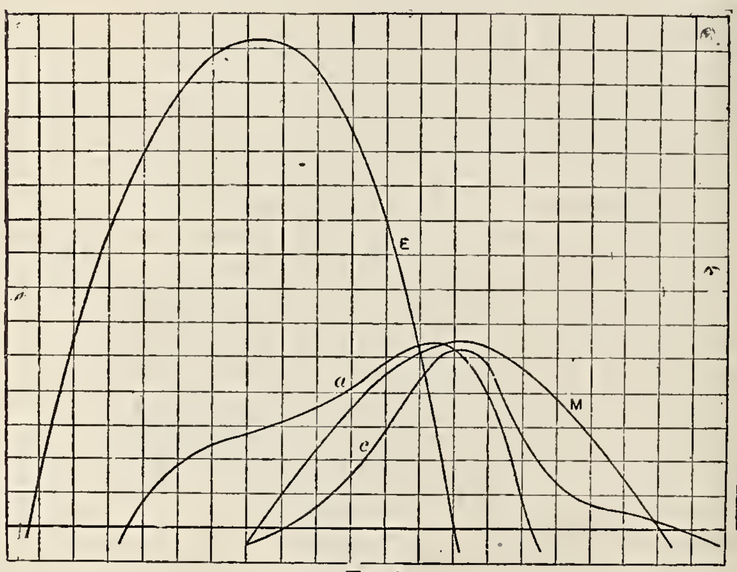


FIG. 2.

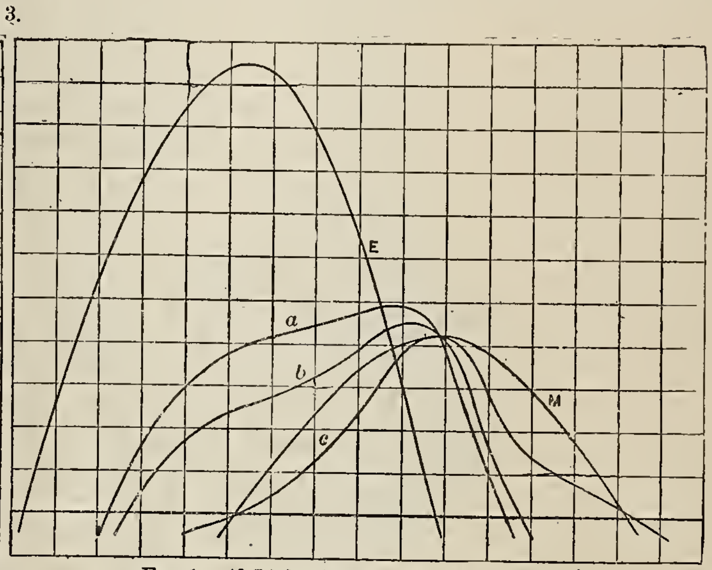


FIG. 1.—40-Light Transformer, 100 v 140 ~

held by Fleming[2], Steinmetz[3] and every other writer since that time, with the single exception of Professor Rowland.[4]

Dr. Sumpner[5] had previously shown that, assuming hysteresis absent, a variation in the value of u will superpose on the sinoidal magnetizing current a system of higher harmonics, causing it to become a symmetrically peaked curve. Professor Rowland, however, went further, and declared that the presence of the distorting harmonics is due, not to hysteresis, but to change in permeability, the effect of hysteresis being capable of representa-

1. Ryan: "Transformers"; "Transactions," vol. vii., p. 1.
2. Fleming: "Alternate Current Transformer," vol. ii., p. 454.
3. Steinmetz: "On the Law of Hysteresis (Part III)"; "Transactions," vol. xi. pp. 731, 743.
4. Rowland: "Notes on the Theory of the Transformer"; "Philosophical Magazine," vol. 34, p. 54. Also: "Electrical World," July 9, 1892.
5. Sumpner; "Philosophical Magazine," June, 1888, p. 468.

of the instantaneous values was essentially similar to the telephone method described by Nichols[1], a galvanometer being substituted for the telephone. A run was also made at 50 volts and 70 ~ and the determination of the watts lost under these conditions, as well as under the preceding ones, enabled us to discriminate the eddy from the hysteresis losses in the usual manner.[2] In this case the total loss was 100 volts and 140 ~ was 55 watts, of which 20.7 watts were due to eddies, and 34.3 watts to hysteresis. If we divide the watts lost by eddies by the E. M. F. applied, we shall obtain the effective current due to eddies, and the ratio of this to the aforesaid E. M. F. is the conductance due to eddies.

If the instantaneous values of E. M. F. be multiplied

1. Ryan: "Transformers"; "Transactions," vol, vii., p. 1.
2. "Transactions"; vol. xi., pp. 718, 719.

by this conductance, and the resulting eddy current curve be subtracted from the original current curve (a, Fig. 1), the remainder will be the hysteresis curve (b), *i. e.*, the curve that would be derived from the hysteresis loop. If in the same way we determine the conductance due to both eddies and hysteresis, *i. e.*, if we represent the hysteretic loss as one due to a simple constant resistance, and subtract the effective current curve thus determined, from the original current a, the remainder c will be a true wattless current, since the curve subtracted itself accounts for the watts lost. In Fig. 1, this wattless remainder is very fairly symmetrical with respect to the flux curve M, and is of the peaked character to be expected with permeability variable and hysteresis absent. A similar treatment of Professor Ryan's curve[1] yielded a wattless remainder (c, Fig. 2), of similar character. These results seemed to verify Professor Rowland's theory, at least approximately.

But equally strong proof is afforded by Figs. 7, 8, 9, 10 in Steinmetz' "On the Law of Hysteresis (Part III.)",[2] for here the subtraction from the original wave, of its equivalent sine wave, leaves a wattless higher harmonic, in each case very nearly symmetrical with respect to the maximum magnetization. Hence these higher harmonics must be due almost entirely to variation in permeability, since hysteresis is essentially unsymmetrical with respect to the magnetization. It is worthy of note that in Fig. 10, in which the original current is most distorted, the wattless higher harmonic is most nearly symmetrical.

The state of the case seems to be, briefly, this: A variable value of μ will superpose upon the wattless sinoidal magnetizing current a symmetrical system of higher odd harmonics, which, since they are symmetrical with respect to the zero of E. M. F., will also be wattless, and the resultant magnetizing current will be a wattless peaked current. If now the transformer be heavily loaded, the sinoidal energy-current will completely hide the magnetizing current both in shape and phase. If, however, the energy-current be comparatively small, we will have a current resultant from a sinoidal current in phase with the E. M. F., and a peaked current 90° behind it, and tending to unduly "boost" the latter half of the energy-current. Hence the dissymmetry is due simply to the conflict between the sine current in phase and the peaked current 90° behind. If either component be very large, comparatively, the resultant will tend to become symmetrical, in the one case a sine, in the other a peaked curve. The sinoidal energy-current may be due to eddies, hysteresis, or secondary load, the effect will be the same.

Curves a, b, c, Fig. 1, show very clearly the effect of the successive elimination from the original current curve of the sinoidal energy-components, due respectively to eddies and the hysteretic loss.

If we take a hysteresis loop, plot a sinoidal flux-curve with the same maximum, and then, at each successive epoch, plot the current value corresponding in the loop to the flux value at that epoch, we shall thus obtain the magnetizing current curve. This method was first used by Humphrey and Powell[1] and has been employed by numerous later writers.

If, however, at each epoch we plot a current value, the mean of those given by the loop for rising and descending magnetzation, we shall thus obtain the wattless magnetizing current. This curve is essentially symmetrical with respect to the flux curve, and consequently, as stated, wattless.

If this wattless magnetizing current be subtracted from the original current, the remainder will be the hysteretic current curve, or, what is the same thing, we may plot at each epoch the half width of the loop at the corresponding flux. A curve plotted between the flux and the corresponding half-width of the loop may be called a *hysteretic characteristic.*

Fig. 3 give a set of half-loops from Ring III. in Ewing and Klaassen on the "Magnetic Qualities of Iron,"[1] with the corresponding hysteretic characteristics, plotted with their maxima together for convenience of comparison.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—STORAGE BATTERIES.

New York, July 13, 1896.

Publisher Electrical Age.

Dear Sir:—Please answer in your paper the following questions:—

(1) In a storage battery, where one plate is placed in a porous cup, is the lead oxide placed between the cup and the plate or on both sides of the plate?

(2) In charging four storage batteries, the smallest plate in one of which has an area of 40 square inches, and the larger twice as great, on a 110-volt circuit; how long would it take to charge them and what current should be allowed to flow through them?

(3) What per cent. of efficiency has a battery of this kind. Yours very truly, Wm. C. Broadhurst.

(A.)—(1) Either way, although it would be much better to have the paste applied to the plate on both sides.

(2) About five amperes is a fair current for this area. You may start with seven and reduce down to five amperes, or less, as the boiling increases.

(3) It is difficult to predict. In all probability from 65 to 75 per cent., at least.

(Q.)—WIRING A LINE OF LIGHTS.

Boston, July 18, 1896.

Electrical Age.

Dear Sir:—The difficulty I have had in stringing a line of lights may be removed by your answer. The circumstances are these: I wired a line of lights ten in a row and fused both rosettes and cut-out; the rosettes repeatedly blow out, either entirely or in part. Kindly assist me in removing this difficulty and oblige, Yours truly,

L. M. Jaeger.

(A.)—Place a ten-light fuse in your cut-out. If the lamps run at 110 volts this will be a 5-ampere plug or link. You might have one there now; if so, remove it and put a 4-ampere fuse in its place. The cause of your trouble is due to a fuse in the cut-out that will not blow before the rosette fuses. By reducing its size it will protect the circuit properly.

(Q.)—INCANDESCENT LAMPS AND FIRE.

Dayton, Ohio, July 16, 1896.

To the Editor Electrical Age.

Dear Sir:—Your valuable column has afforded me such satisfaction that I believe you will relieve me of further doubts on this subject. Can an incandescent lamp set fire to a house? Are not all fires caused by blowing of fuses or a short-circuit of some kind—I mean when traced to the current? Yours respectfully,

Edward Norton.

(A.)—If a piece of paper rests on a lamp globe it will become scorched and take fire. The Board of Underwriters have decided that lamps will cause fire due to radiant heat. A continued short circuit, in a case where the fuse will not blow, would cause a fire. An old lamp should never be burnt near flmsy materials, such as curtains, tissue paper, etc., because a conflagration may crop out any instant.

(Q.)—X RAYS IN THE FLESH.

Chicago, Ill., July 12, 1896.

Electrical Age Publishing Co.

Dear Sir:—Can you tell me why X rays, which are streams of energy, can pass through the flesh without injuring it? I thought that energy passing into the body always affected it in some way. Heat and electricity will, why not X rays?

(A.)—Magnetism is a form of energy and does not affect the body. Intense light enters the tissues a certain depth without affecting us. The X rays are similar in some respects; they possess many characteristics

which have excited a world of discussion. The X rays which enter the body are not possessed of great energy, and, even if they were, our senses are dead to their effects. This is not the only strongly manifested force passing through us. Gravitation acts likewise without our having the least physical perception of its presence. The fields of science are widening, but our vision is still very limited.

FRANKLIN LEONARD POPE.

In Memoriam.

(Concluded from page 394.)

In 1880, the astounding developments in the introduction of electricity for light, power and heat, and to various other important uses, attracted capitalists at a time when capital was plenty. Patents in this branch of industry were being issued by the thousand, and there was a great demand for expert knowledge to guide and protect the large resulting investments. Realizing this state of affairs, Mr. Pope established himself as a patent lawyer, solicitor and electrical expert, with offices at No. 32 Park place, New York City, and subsequently at Nos. 59, 11

WAINWRIGHT HALL.
(BUILT 1776 REMODELED 1893)
Corner South Main and Pope Streets, Great Barrington, Mass.

and 15 Wall street. He afterwards formed a partnership with his associates, which continued under different firm titles until 1894, Mr. Pope's name appearing always as senior partner.

Mr. Pope was a member of the British Institution of Electrical Engineers ever since its inception in 1872, also one of the first vice-presidents, and the second president of the American Institute of Electrical Engineers. He was also elected vice-precident of the American Electrical Society of Chicago, in 1878, and during the following year contributed to its journal the ablest and most interesting paper upon the "Life and Work of Joseph Henry," that has ever appeared.

In this admirable tribute to Henry's transcendent genius and spotless character, Mr. Pope says:

"There is to me a singular fascination in tracing the footsteps of the pioneers of science and discovery; in visiting the places which have been the scenes of their struggles, their disappointments, and their triumphs; in handling the crude and roughly-fashioned apparatus, frequently the work of their own not unskillful hands; and in gathering from the lips of eye-witnesses the anecdotes and reminiscences which tell the story of their lives and work and studies."

"With such thoughts as these, I found myself one crisp, clear autumn day, not many weeks ago (1878) strolling beneath the venerable elms that shade the campus, and droop their branches lovingly over and around the classic halls of Princeton."

A key is here furnished to the inspiration of so many of Mr. Pope's articles, particularly to the notable one in "The Electrical Engineer" of 1891, upon "The Inventors of the Electric Motor."

In 1884, Mr. Pope secured an interest in, and became the editor of "The Electrician," which was started in 1882. He changed its name to "The Electrician and Electrical Engineer," and continued to conduct it as a monthly electrical journal until 1890. Before retiring from its active management, the title was changed to "The Electrical Engineer," and it was soon made a weekly. He also edited the electrical department of the "Engineering Magazine." His very last literary work was a contribution to the latter on the "Distribution of Electric Power at Niagara." He left the last sheet of this unfinished article in his typewriter the night before he died.

In his professional capacity during the past 20 years, he had been retained by some of the largest and most influential concerns in this country, among them the Postal Telegraph Company, the American Bell Telephone Company, and the Westinghouse Electric Company, and it was mainly through his investigations and recommendation that the latter company undertook the exploitation of the alternate current system, now so generally in use.

In the fall of 1894, Mr. Pope made an important change in his business plans, which had long been in contemplation. He had several years before acquired the title of the homestead at Great Barrington, and at considerable expense had converted the old brick house, built in 1766, to a modern country mansion, which he named Wainwright Hall, in remembrance of his mother's family name, and the former owner of the property. While at Great Barrington he continued to serve his clients in the capacity of expert, and as a pastime also undertook to remodel upon the best engineering lines the plant of the Great Barrington Electric Light Company, utilizing the valuable water power of the Housatonic River. Of this important work a most interesting account was given by Mr. Pope in a paper read before the American Institute of Electrical Engineers, June 26, 1895.

It is not too much to say that to Mr. Pope, more than any other, are American telegraphers and electricians indebted for free enlightenment upon subjects in which they were naturally interested, through his able contributions to the various electrical and scientific journals, encyclopaedias and magazines of this country.

He had at all times shown the greatest interest in electrical organizations, as well as literature, believing thoroughly in the general welfare which followed the exchange of ideas through these channels. One of his strongest characteristics was his readiness to tender his advice and a helping hand to all with whom he came in contact, who were striving to acquire knowledge in the electrical field.

In 1886, Mr. Pope prepared for the Berkshire (Mass.) Historical Society, of which he was a member, a paper on the western boundary of Massachusetts, embracing a study of Indian and colonial history, and it is surprising to contemplate the painstaking research into the unpublished manuscript archives of the adjoining States, including county and town records, and the immense labor involved in the compilation of such a valuable history which is highly treasured by all interested persons.

Although firm in his convictions and intrepid in his statements, Mr. Pope was exceedingly unassuming. Above his intellectual attainments and skill, his integrity towered as unyielding as an Egyptian pyramid. He was conscientious and painstaking. To his keeping, his clients had frequently consigned immense confidential interests. He made their cause his own, and with a deep sense of responsibility, spared no efforts to base his advice or action upon a complete knowledge of the underlying facts.

His electrical library was one of the best in this country, and his untiring industry in the pursuit of knowledge made him a frequent visitor to many of our similar public institutions.

Francis W. Jones.

The Electrical Age.

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CONTENTS.

	PAGE
EDITORIALS	411
Generators of Power	
Experience	
Standards of Light	
GENERAL SUBJECTS	
Testing of Circuits	412
An Analysis of Transformer Curves	408
Franklin Leonard Pope	410
Applications of Motors	405
MISCELLANEOUS	
Advantages in Electric Heating	415
EXTRACTS	
Roentgen Rays	413
Interesting Facts in Science	414
INQUIRY COLUMN	409
TRADE NOTES	
The Vetter Cement Tap	414
Special Notice	414
Complete X Ray Outfit	415
J. H. Williams & Co.	418
Canadian Letter	419
Possible Contracts	419
Telephone Notes	419
NEW CORPORATIONS	419
New Telephone Companies	419
PATENTS	420
Telephone Patents	419

GENERATORS OF POWER.

To produce a current of electricity seems a simple thing to do. To transform it into light, heat or power, with our present appliances, equally so. Then we say the work is ended. Let us see whether this is true or not; let us inquire more deeply into the conditions, not only determining the value of apparatus that transforms, but also that which, in the accepted sense of the word, generates electricity.

It is strange to step back into some old footprints and see the landscape crowded with new sights, which have hitherto escaped our notice.

We may do the same in examining the two parallel streams of engineering practice—generators and motors. The motor has satisfied us all of its value, efficiency and general excellence. But the dynamo, can we disassociate it from the engine? Turbines using water-power are few and far between; they are not ours for future use. The engine and dynamo are wedded together—the perfection and efficiency of one, the distinct lack of both in the other. We have passed far beyond our sources of energy. The generation of power has not kept pace with the devices that transform it. We are, perhaps, years ahead of our steam-engines. Will the engine and dynamo always be in close communion? The air of expectation is visible on all sides. The boiler and battery are the stars that sparkle with meteoric brilliancy as if reflecting the hopes we place in them.

EXPERIENCE.

Age conspires with experience to make men wise. At times the coexistence of both interferes with the projection of wild schemes to a great extent. Unfortunately, in the majority of cases the combination does not exist. Age without experience is harder to bear than leprosy; yet youth, with experience, is scoffed at. The youth, as a rule, never believes this to be true until he offers his unsolicited opinion. Age has its failings and strong prejudices, which assert themselves on every available occasion like the experience of the youth. Both, as a rule, suffer. The value of experience is said to be appreciated. A lathe hand or a carpenter fetch their price; but how about the man whose mental tissues have been hardened into steel by the blows and rebuffs of the world? He cannot turn or saw wood. He knows by bitter experience the value of the real, yet can show nothing to prove it. Give him a chance and he will succeed, but for every chance there are a thousand men. What is his experience worth? Is it not better to turn or saw wood? What does he lack—a man seemingly so competent, steeped in experience? We know. He lacks the entering wedge. The technical knowledge required to give him a primary value. Experience must be directed in a given line, like a force, and its effect is felt like the hammer's blow.

STANDARDS OF LIGHT.

The difficulty in scientific circles of selecting a standard of light has been felt for many years. Light is energy as much as magnetism or heat. If it could be quantitatively measured by the amount of energy it represents some substantial basis for future work would exist. But at present power may be consumed that will lack in every respect an expressible relationship with the light produced. What is the equivalent in energy of 100 candle-power? Let us see. By electrical means 100 c. p. may be produced by the consumption of 300 watts in an incandescent lamp or 100 watts in an arc lamp. In a gas jet it would require about 30 cubic feet an hour, which amount can be evaluated in power. And as an oil light, we would meet with another quantity of energy.

This is the point causing such doubt amongst physicists. How shall light be correctly evaluated as power? What standard is most reliable? The study of light measurements has opened up several new and ingenious methods of obtaining a standard. The best, it seems to us, is the one suggested in the paper called "Standards of Light," the use of a platinum strip of known area raised to a given pitch of incandescence. The area giving issue to light, the temperature and the amount of light obtained are easily determined. With so excellent a means at hand a standard of light ought to quickly adopted, because on all sides its need is felt.

MATTFR WITH NO ATOMS.

Investigations as to the minuteness of some waves and the conditions for producing such waves has led to the conclusion that the ether is not granular; that is, it is non-atomic. It is described as being a continuous medium, to signify that there are no pores or interstices in it—another quality which distinguishes it sharply from gravitative matter. Neither is there any evidence that it is subject to friction, for bodies which have been moving in it for no one knows how long, have not had their rates of motion changed by it. Comets have been known to move in the neighborhood of the sun with the velocity of nearly 400 miles per second and not to suffer retardation, and light itself does not appear to be absorbed in any degree by travelling in it for any length of time. If it were, some stars would be coming into view in the direction in which the solar system is travelling, and others in the opposite direction would be dropping out of sight. Hence we speak of it as being a frictionless medium.

TESTING OF CIRCUITS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In measurements of candle-power a great difficulty has been met with which, although partially overcome, still leaves the final settlement of it in doubt; that is, the use of a standard of light. A gas jet gives sixteen candle-power, an incandescent lamp sixteen, and possibly some oil lamps, but should either be adopted as a standard it is very difficult to keep track of the deterioration in light and feel secure, in using it, that no great error is made. In other words, we have no absolute standard of light, and therefore our methods, though perfect, have not a very accurate foundation. The use of a fixed standard is necessary. In order that a test can be made which will amount to more than an experienced guess, a good reliable standard which will not change very quickly is most desirable. The standards at present in use vary somewhat in their nature. The English candle has been looked upon as best for a long while, but opinions have been slowly changing. The use of other standards has become general, and the following sources of light for photometric tests tried with a variety of results:

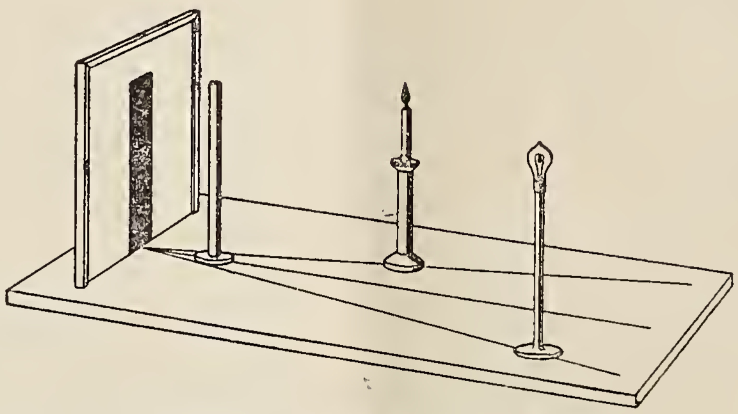
Standards of Light.

- Carcel lamp,
- British standard candle,
- German standard candle,
- Amyl-acetate lamp,
- Pentane lamp.

The above are but a few of those that have been tried. One method that appeals to the electrical engineer is the heating of a strip of platinum to a given temperature by a known current, or the light emanating from a crater in an arc lamp. The paper entitled "Standards of Light," read before the American Institute of Electrical Engineers, May 20, 1896, is very complete, and treats this difficult problem in a masterly manner.

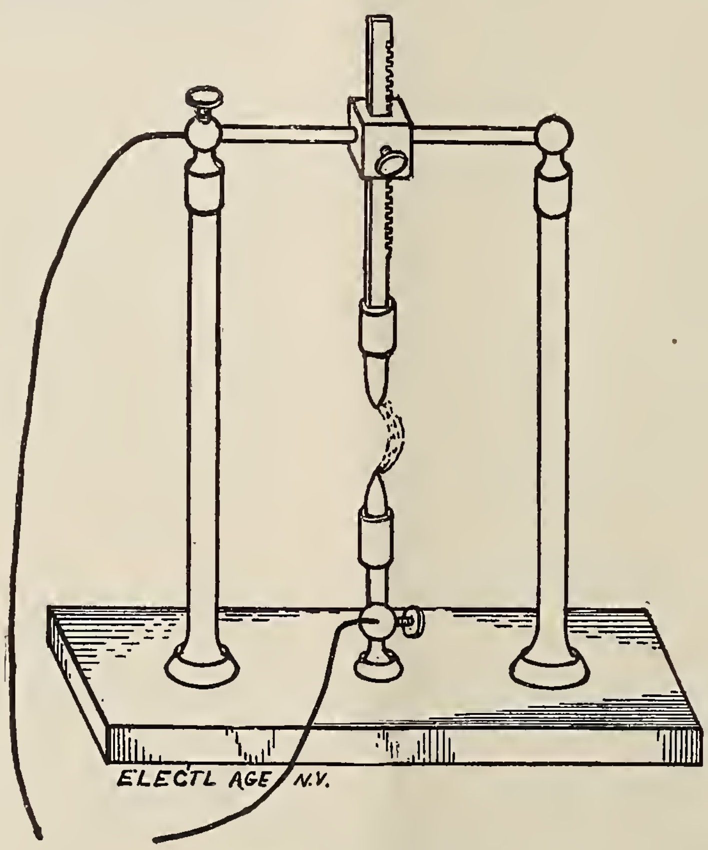
The standard that cannot be depended upon is the English candle; in fact, any source of light subject to such fluctuations and burning with such unsteadiness.

The standard must be of definite chemical composition as well as the medium around it. When a light has been produced that shows but slight variations, the problem of measuring light will be resolved down to a firm basis and become in every sense of the word a science.



RUMFORD'S SHADOW PHOTOMETER.

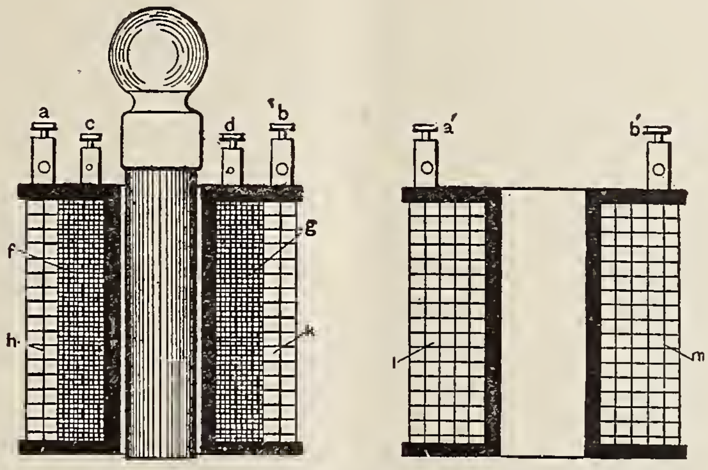
In lamp factories a filament carefully made is selected and its candle-power, measured with all possible accuracy, used as a standard for the rest. A dark room is very essential for lamp tests. In any factory making illuminants or apparatus for such, a photometer room is used constantly. It is simply a room shut off from all daylight. A scale is within; at one end the standard is placed, at the other the light to be measured. Either one is now kept stationary. The screen between with grease spot is used, as in the simplest photometer, for deter-



PRIMITIVE ARC LAMP.

mining the equivalence of the intensity of light on each side. Rumford's photometer employed a screen and made use of the shadows thrown by the standard and other light as a means of comparison.

A stick mounted before a screen will throw two shadows, one due to the standard, the other caused by the unknown light; when both shadows are alike, the respective distances are compared. If the standard is one foot away and the other three feet, provided the shadows thrown are equal, the second is nine times as strong as the first, or nine candle-power.



COILS FOR ELECTRO-MAGNETIC INDUCTION.

Daylight is the light all scientists and inventors are striving to obtain. Their object is to produce light without heat, and thus illuminate city and home in the most perfect manner.

Electro-Magnetic Induction.

The many phenomena brought to our notice by the action of a current are still more wonderful when the current acts upon another. It is strange that to-day we are just waking up to the fact that many of the effects around us are due to the presence of an invisible and extremely fine atmosphere called ether. It is not necessary to know what ether is in studying its effects, only that its presence be remembered, and its qualities, as far as they are known. In studying the principles of electro-magnetic induction we are compelled to look upon the subject as we would gravitation; that is, in each case one body is capable of affecting the other without any visible material between. But we know that one exists, as well as we know that air, or hydrogen and oxygen are realities. It is always surprising to see one body influence another, as, for instance, a magnet a piece of iron. Yet the old effect of the earth on a stone is constantly forgotten. Familiarity with certain electrical experiments makes them lose novelty and become accepted with unconcern as the most prosaic truth to be found.

A coil of wire carrying a current becomes surrounded with magnetism. If the current changes the magnetism does likewise, and even the minutest variation is distinguishable at once. Another coil in the vicinity of the first can only be affected if these changes occur. Either the current must increase in the first coil or it must decrease; in either case, the second coil produces a current. A steady and uniform current in the first coil produces no lasting effect in the second. But when the current is started the second coils show it, and when it is stopped. Each of these changes, however, mean an increase or decrease of current in the first coil, and it is in these changes that the phenomena of electro-magnetic induction occur when another coil is present.

Currents may be divided, according to their nature, into four kinds at least:

Uniform current,
Pulsating current,
Alternating current,
Interrupted current.

The coil receiving these currents will affect any neighboring coil in the same way. If it be connected to a galvanometer, the pulsations and changes can be clearly noted. The circumstances governing the intensity of this effect are deeply interesting. It is a department of science which touches upon a new field of facts—the study of action at a distance.

ROENTGEN RAYS.

Horse-Power of a Gun.—The basis on which the assertion has been made that a gun is of several million horse-power is explained by the California "Scientific Press":

"The 100-ton gun, with a 550-pound charge of powder, throws a projectile weighing 2,020 pounds at an initial velocity of 1,715 feet per second, thus communicating to it a live power or kinetic force of 92,597,000 foot-pounds. The thrust exerted by the gas due to the ignition of the powder lasts less than the hundredths of a second, the result being that during the active period of the work of the powder in the gun the mean power is greater than 87,000,000 foot-pounds per hundredth of a second, say 8,700,000,000 foot-pounds per second, and this represents a power of 12,000,000 kilo-watts, or 17,000,000 horse-power. But, though large guns are thus extraordinarily powerful, their active life is essentially ephemeral, since after a hundred shots they are generally out of service; they have then worked actively one second."

Melting Wrought Iron.—In the melting of wrought iron it is necessary to heat it to a much higher temperature than is usually obtained in the cupola, in order to reach the fluidity necessary to secure a clean, sharp casting, and the resultant castings are of very inferior quality. There is, however, a process of making wrought iron castings, known as the "Mitis" process, which is substantially as follows: The charge of wrought iron is heated to a temperature of 2,200 degrees C., at which heat it assumes a pasty condition, when from 0.03 to 0.05 per cent. of aluminum is introduced in the shape of ferro-aluminum (6 per cent. aluminum). The metal at once becomes fluid, and will produce good, sharp castings, retaining all of the characteristics of wrought iron, except the fibre. Cast iron and steel borings and turnings may be melted in the cupola, in the proportion of 10 to 15 per cent. with high silicon pig, and will make good, strong castings, but the "Engineer" argues that it would not be advisable to attempt to melt wrought iron turnings in a cupola.—Engineering and Mining Journal.

Wasted Coal.—Anent the various ways in which coal may be, and is, allowed to go to waste in all coal mining regions, it is worth noting that, according to an estimate of the late Eckley B. Coxe, the amount of coal lost in preparation and sent to the culm banks in the anthracite district of Pennsylvania, since mining began, has been 35% of the total production, or, up to the close of 1892, a total of 315,700,000 tons. At certain collieries, from the year 1820 to 1883, 20% more coal had gone to the dirt banks than had been marketed, and from 50 to 75% of total shipments to dirt banks was not unusual. In view

of these facts, the statement that, on the average, during the last fifty years not more than 30% of the coal mined has reached the place of consumption is not at all surprising.—Cassier's Magazine.

Titanium.—Among the latest products of the electric furnace is the metal titanium, a metal which hitherto has probably only been seen in small quantities, and rarely outside of the specimen cabinet in a chemist's laboratory. It is an extremely refractory substance; in fact M. Moissan, whose researches with the electric furnace are well known, states that it is the most refractory that he has yet obtained, being more infusible than vanadium, and far more so than molybdenum or zirconium. It has only been prepared in the electric furnace at the highest temperature, and by means of a dynamo using 100 h.-p. The general properties of titanium resemble those of the metalloids and particularly silicon. In a recent issue of the "Bulletin de la Société Chimique de Paris," Moissan has a paper of considerable length describing his experiments and defining the properties of their product.—Engineering and Mining Journal.

THE VETTER CURRENT TAP.

This simple device will be found useful wherever the incandescent electric current is employed for lighting purposes, as it is designed to facilitate the transmission of the light or power of the current to any desired point in the vicinity of the fixture, and thus virtually doubles its capacity. As the name indicates, it "taps" the current, and does it in so simple a mauner that a novice can use it without the slightest difficulty.

By the Vetter Current Tap the current can be carried from the electrolier to a drop light or fan motor without the loss of the lamp at the point where the current is tapped.

Many offices are supplied with only one or two single wall brackets, and the use of a drop light or fan motor generally means the loss of the lamp, by the substitution of the socket plug for the same at the fixture. The Vetter current tap, however, leaves the lamp where it is, and carries the current to any desired point; in fact, from a single wall-bracket can be obtained by means of the tap, a wall light, a drop light and current for a fan motor, thus furnishing both light and comfort.

In every office, factory or home, wherever the electric current is in use, the Vetter current tap will be found a great comfort and convenience. An illustration of this current tap can be seen on another page. It is manufactured by J. C. Vetter & Co., No. 104 East 23d street, New York.

SPECIAL NOTICE.

The Hazleton Boiler Company, New York City, report recent sales of boilers, aggregating 2,450 h. p., among which we notice the following: The Rochester Gas and Electric Co., Rochester, N. Y., 500 h. p.; the Bristol Electric Light & Railway Co., Bristol, Conn., 200 h.p.; the Canandaigua Electric Light & R.R. Co., Canandaigua, N. Y., 250 h. p. The Hazleton Company report that nearly all of their orders now being received are for the very earliest possible delivery, and that many of their recent sales have been made to old customers who are now enlarging their plants. The original boilers sold to these customers have been in constant operation for from eight to ten years without repairs, still carrying high pressure, and giving the same fine results as when new. This, together with the fact that the Hazelton Company has made various improvements in the construction and setting of their boilers, increasing their efficiency and economy and improving their appearance, makes it much much easier for them to make sales now than formerly. These facts are not only gratifying to the company, but also seem a pretty sure indication of an improved feeling and condition in manufacturing business generally throughout the country.

Interesting Facts in Science.

Acetylene Motors.—A paper read by Mr. Ravel before the French Société technique de l'Industrie du Gaz at their meeting at Clermont-Ferrand last month is reproduced in the "Revue Industrielle." Mr. Ravel has been going into the matter experimentally, and does not appear to think that the new illuminant is going to be any good for motor purposes. If a large proportion of acetylene is used in the working gas mixture the explosion is too violent for convenient use, while if the acetylene is diluted to avoid this the heating power is not what it might be. Mr. Ravel says: "Perhaps this gas will find its application in rotary engines or turbines, but on that path, thorny enough in itself, there are practical difficulties of the first order to be encountered." Why anybody should choose for a motor what is eminently an illuminating gas is not very clear. Moreover, acetylene has to clear itself of the suspicion, whether ill-founded or not, that when under pressure it may explode of itself. Mr. Ravel does not seem to have been quite happy himself on this point when in the course of his experiments he found his generator getting hot.—London Elec. Engineer.

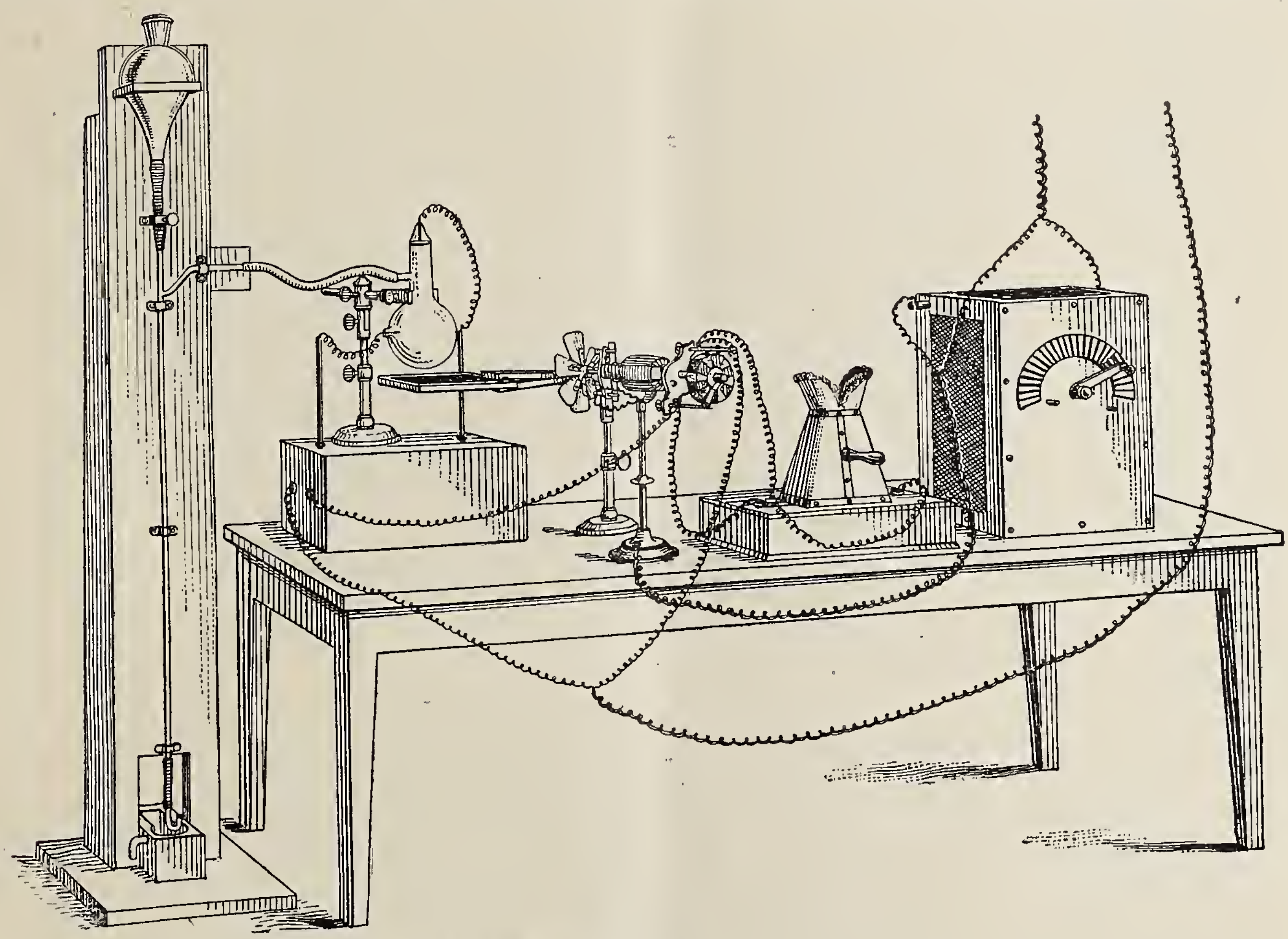
High Temperatures.—There are three ways by which high temperatures may be measured. The first uses an air thermometer of refractory material; the second depends on the change in the resistance of a platinum wire with change in temperature; and the third is based on the employment of a thermo-couple of relatively infusible metals. According to Messrs. Holborn, and W. Wien, in a paper published in "Wiedemann's Annalen," the air-thermometer method was valueless until recently, as suitable vessels could not be made. But now these are produced from refractory clays, and permit of measurments up to 1,500° C. (2,732° F.). The results are however, vitiated by the effects of capillarity in the interior of the vessel. The resistance method has also its disadvantages. At high temperatures the resistances generally increases, but the temperature coefficient is irregular. The presence of free hydrogen also affects the resistance. The third or thermopile method is favored by the authors, who prefer a circuit of platinum and an alloy of platinum with 10% of rhodium. Temperatures up to 1,600° C. (2,912° F.) can be measured by it, and it is remarkably constant under various conditions.—London Elec. Engineer.

Electric Vulcanizer.—One of the most important branches of bicycle work is the repairing of tires. To properly combine two pieces of rubber into one mass it is necessary to subject them to an absolutely uniform definite temperature for a stated period. This is now accomplished by the electric vulcanizer. Steam heat or heat from a gas flame requires constant attention, while electric heat involves practically none. Fire risks and the danger of steam or gas explosion are entirely avoided, and the electric method gives a sure and satisfactory result with but little skill or experience on the part of the operator, besides obviating the chances of burning the tire. The machine occupies a space of between two and three feet, and can be set up on any substantial table or work bench. Several tires can be repaired at one time. The heat is applied by the turning of a switch, and each successive turn from right to left increases the amount of heat applied. The proper temperature for any particular piece of work in hand can be accurately determined by a simple test of the rubber, and the correct position of the switch for subsequent operations is thus fixed. The electric vulcanizer is now used by many of the best manufacturers of tires in the country.—Tradesman.

A storage battery plant will soon be installed in the Custom House. The batteries will consist of 130 cells of chloride accumulators and will be used as an auxiliary to the plant now in operation.

COMPLETE "X" RAY OUTFIT.

The Standard Lamp and Novelty Co., of No. 248 West 23d street, N. Y., sell a finely finished X ray outfit which will satisfy the most critical as regards price and quality. It is practically complete in every respect, as it includes all the apparatus necessary for continued work, including the means of preserving a perfect Crookes tube vacuum. It consists of thirteen parts, which are exposed to open view, as in the sketch. A six-inch spark coil with a rotary

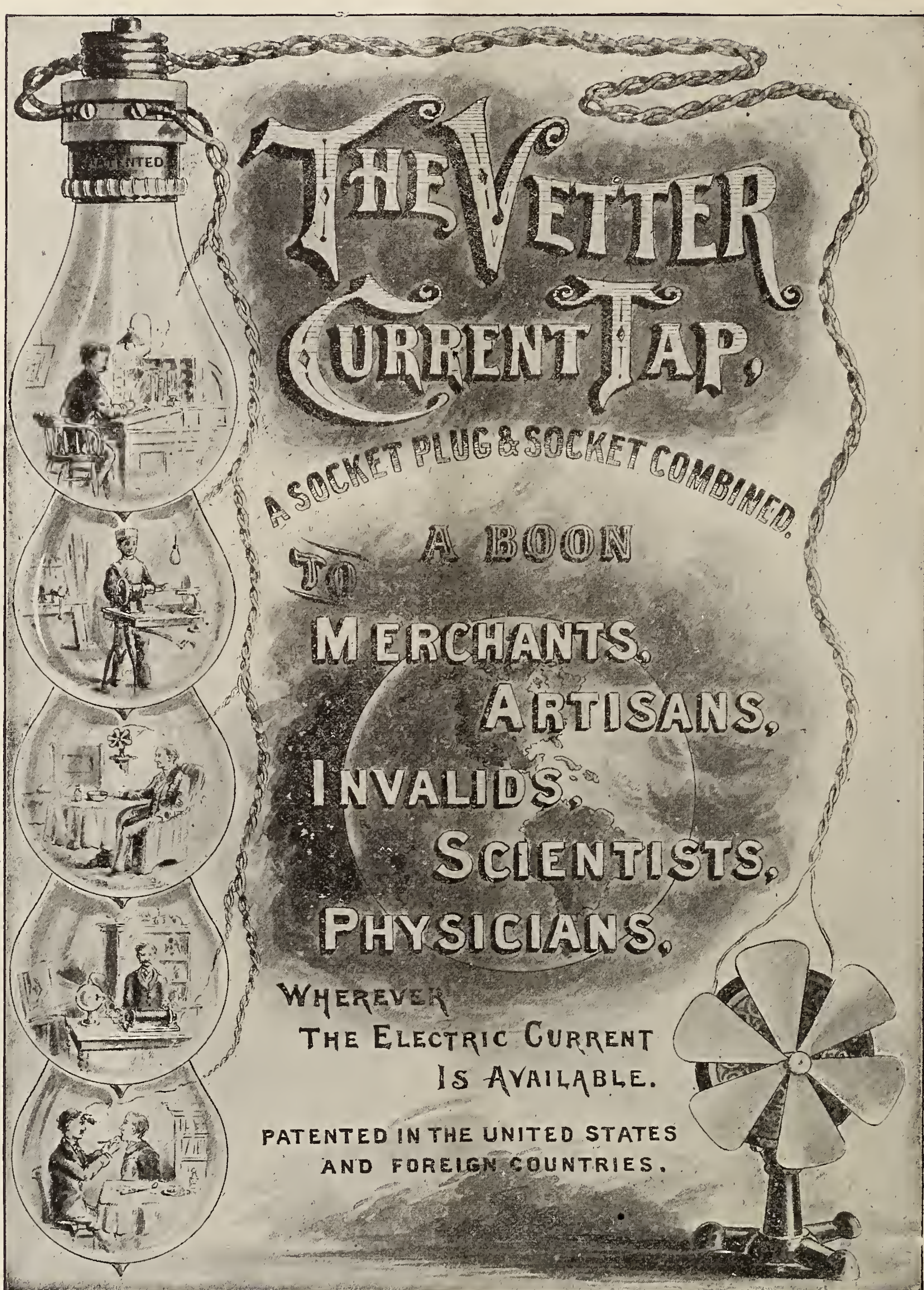


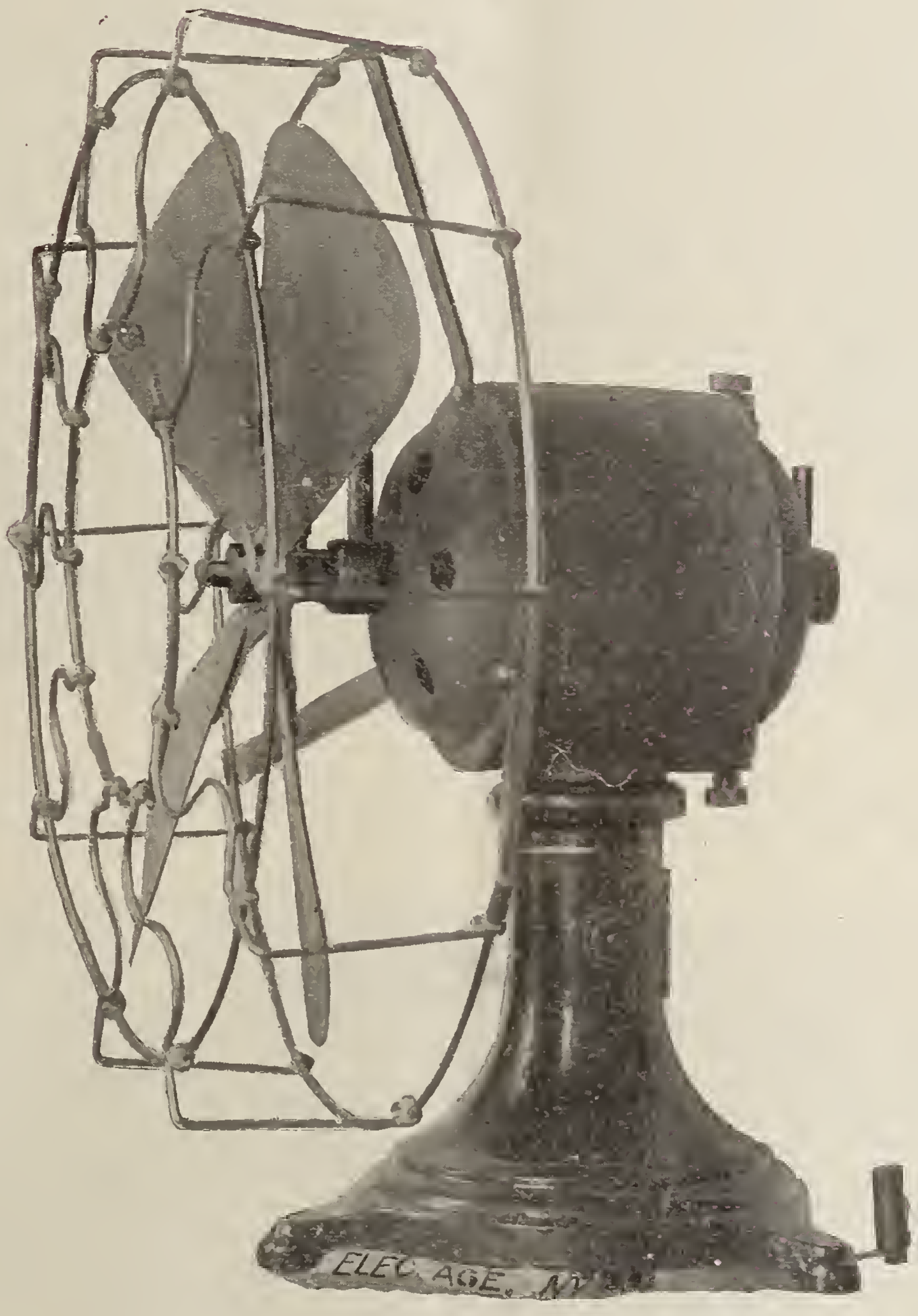
STANDARD LAMP AND NOVELTY CO.'S X RAY OUTFIT.

interrupter which makes 24,000 breaks a minute. The interrupter is 3½ inches in diameter. In addition to the coil is a large condenser containing 509 square inches of surface, well insulated and of high capacity. A motor with a 6-inch fan and battery having an output of 10 amperes and 12 volts, to run the same. The fan is controlled by a switch as well as the coil and used for cooling the Crookes tube. Eighteen feet of wire insulated by soft rubber tubing, ⅜-inch outer and 1-32-inch inner diameter, for the purpose of securing perfect insulation, is used in connection with the coil. A Crookes tube loses its vacuum as it is being used, and to sustain it a pump must be continually operated. The Lamp and Novelty Co. give a Sprengel pump and twenty-five pounds of redistilled mercury. An upright adjustable holder or clamp of three links, for the purpose of holding the tube and dry plate, removes many difficulties. A fluoroscope with a calcium tungstate screen is supplied, which shows up very clearly coins in books or the bones of the hand and arm when the tube is utilized. This splendid set of X ray apparatus gives every advantage to the student, physicist or showman. The Crookes tube will never become useless, so that a great item of expense is removed. All the features required for a successful outfit may be procured by buying one of these excellent and serviceable sets of apparatus.

ADVANTAGES IN ELECTRIC HEATING.

Some interesting facts in regard to the steady extension of electric heating are brought out by W. S. Hadaway, Jr. More large contracts for electric car heaters have been closed during this winter than ever before, and there is every evidence that the electric car-heater has become a staple commercial device. While most of the electric car heaters now made fail to meet the conditions of ideal car heating, the fact that several thousand cars are being equipped with them is significant testimony as to their value. As a matter of fact, the heating of cars by electricity is more expensive than by the ordinary methods, but as a well-known street railway expert says, the decision for or against heating in any particular case must be reached on the distinct basis that collateral advantages and not coal economy form the real criterion. The manager of a large plant which has been using heaters this winter with a considerable expenditure of power, says that it costs him much more, in fact, about four times as much, to heat his cars by electric heaters as it did by coal stoves. He says, however, that he saves two seats in the car; the people like the system of heating, and the cars are more attractive for this reason, and that on the whole he believes in it, and would not go back to the old system, nor would he fail to adopt electric heating if the decision were to be made again. For the heating of buildings electricity is rapidly making its way, especially in England and France. It received quite a stimulus from its successful application to the heating of the Vaudeville Theatre in London, where a low-pressure hot water system was used. The necessary furnace was found to be an incumbrance and an extreme inconvenience, and by using electricity this difficulty was overcome. It was found that in ordinary cold weather only two or three hours' heating were required, while with the hot water system it was impossible to limit the time, as the water took two or three hours to heat up, and the same to cool down. The electric radiator is now the favorite method of heating offices, libraries, cabins of steamships and yachts, bathrooms of houses, etc. The cost of heating a bathroom, say 20 minutes each day, is 3 1-3 cents, or practically $1 a month. The cost of electric cooking is, roughly, 2.5 cents per person per meal, which compares favorably with other sources of heat for cooking. One singular application of electric heating is reported from a brush factory for the warming of the pitch used to fasten bristles in the brushes. When the factory was built the problem of obtaining high temperature for heating pitch and other applications without employing gas or other forms of flames or fire in the shop presented itself, and the underwriters were appeased by


PATENTED
THE VETTER CURRENT TAP,
A SOCKET PLUG & SOCKET COMBINED.
A BOON TO
MERCHANTS,
ARTISANS,
INVALIDS,
SCIENTISTS,
PHYSICIANS,
WHEREVER
THE ELECTRIC CURRENT
IS AVAILABLE.
PATENTED IN THE UNITED STATES
AND FOREIGN COUNTRIES.



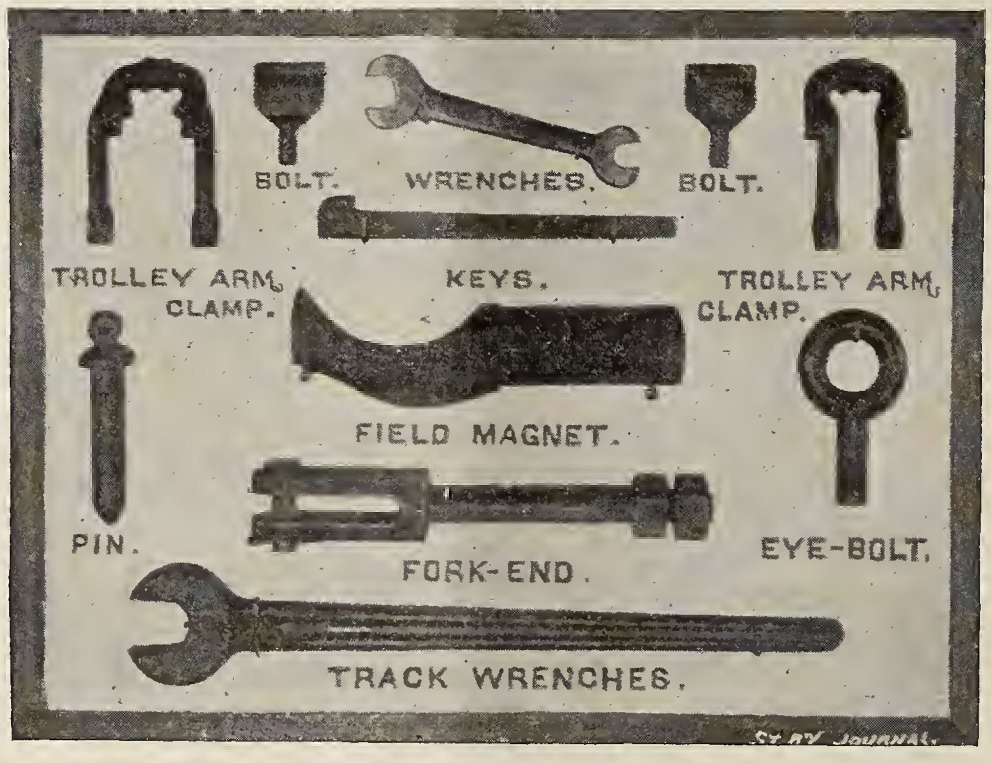
the adoption of electricity for the purpose. Other novel applications of electric heating mentioned by Mr. Hadaway are to maintain the needed high temperature of 125 9-pound sadirons in a linen factory, and the heating of the water baths of 50 glue-pots in a book bindery. Where the health of the workmen is considered, the use of electric heating in place of flame or fire greatly simplifies the problem of ventilation.—The Tradesman.

J. H. WILLIAMS & CO.

It is very important in the manufacture of dynamos and motors that the quality of iron used be of the best, the shape of the metal of good design and the grain conform as closely as possible to the magnetic circuit. This can be achieved by means of drop forgings, which are admirably adapted to this end. The presses required for the shaping of these parts must be accurate and strong enough to secure a clear surface and a perfect outline. The firm of J. H. Williams & Co., Nos. 9-15 Richards street, Brooklyn, devote themselves to the manufacture of these specialties. Either iron, steel, bronze, aluminum or copper are stamped into any desirable shape. The cuts show a line of sample parts such as may be used by firms manufacturing motors or dynamos. Also the appended ilustration shows the interior of their shop with its long line of presses busily at work.

A system of drop hammers and forges such as they possess are not to be found everywhere. Not only are thousands of sets of motor forgings turned out, but wrenches, lathe dogs, thumb-screw and nut blanks, and Brock's patent chain pipe wrenches. It is possible to get almost any form of forging, large or small, turned out here in a reasonable time.

Homogeneity, smooth surfaces and correct outlines are the points that require absolute fulfilment if success is to be permanently established. J. H. Williams & Co. have achieved all these desirable qualities in their work, and the good will of all their customers lies with them.



SOME SAMPLE FORGINGS.

FACTORY OF J. H. WILLIAMS & CO.

Gallipolis, O.—The city voted July 8 to issue $15,000 in bonds to establish an electric lighting plant.

St. Louis, Mo.—The Skeen Electric Switch and Signal Co., of St. Louis, Mo., has increased its capital from $5,000 to $10,000.

CANADIAN LETTER.

Peterborough, Ont.—Tenders are being received by S. R. Armstrong, town clerk, for lighting the streets of the town of Peterborough with 80 or more arc electric lights of 2,000 candle-power each, to be placed as directed by the council, through the Chairman of the Fire, Water and Light Committee, and to remain lighted all night. Form of contract can be had from the town clerk.

Sturgeon Falls, Ont.—The question of securing a system of electric lighting is under consideration.

Newfoundland.—An electric railway is being arranged for St. John's, to be operated between the city and suburban villages within twenty miles. The plant is to be driven by water.

Hull, Que.—At the first annual meeting of the Hull Electric Railway Company, held recently, arrangements were made for building loop lines and erecting a large summer hotel at Hull. Mr. Alexander Fraser was elected president and H. D. Spencer managing director.

Toronto, Ont.—Messrs. Dewart & Reney, solicitors, have given notice that application will be made to the Dominion Parliament for an act to incorporate the Toronto Radial Railway Company, with the power to take over the franchise of the Toronto Belt Line Railway Company, and to convert the present belt line railway into an electric road.——The Canadian Electric Railway and Power Company is seeking incorporation, with power to build an electric railway from Cobourg to Niagara Falls via Port Hope, Bowanville, Oshawa, Whitby, Toronto, Oakville and Hamilton.

J. Alcidé Chausse.

POSSIBLE CONTRACTS.

New York City.—It is John Jacob Astor's intention to erect a twelve-story mercantile building on the corner of Broadway and Duane street, which was conveyed to the William Astor estate recently. Mr. Astor's address is 23 West 26th street.

The New York Savings Bank will erect a four-story brick bank building and dwelling on Eighth avenue, corner of 14th street, at a cost of $220,000.

The new hospital to be located at 16th street and East River, which will be known as the Hospital for Scarlet Fever and Diphtheria Patients, will cost about $130,000, of which $100,000 has been subscribed. The main division of the institution will consist of three buildings.

A six-story fireproof structure will be erected by the Society for the Prevention of Cruelty to Animals on the northwest corner of Madison avenue and 26th street.

A twelve-story skeleton-constructed store and apartment house will be erected by Wallace C. Andrews at 59th street, near Madison avenue, at an estimated cost of $100,000. Plans are being prepared by L. K. Davis.

Columbus, O.—Specifications have been prepared and bids will be called for a five-year contract for city lighting. The specifications provide that the contract shall be for five years; that the contract shall be for 700 or more arc lamps of 2,000 candle-power, by the overhead system, and 50 arc lamps of equal candle-power by the underground system, operated with not less than 460 watts; that the lamps shall be enclosed in glass globes, the lower half of which shall be ground or enclosed in a clear outer globe with a modifying inner globe; that there shall be not less than 50 lamps to a circuit; that all lamps, hoods, carbons and globes shall be of the latest approved pattern.

Minneapolis, Minn.—A municipal conduit system is quite certain to be built this year, and it will be large enough to accommodate all the electric companies. Such a system will cost $50,000, and will necessitate a bond issue, if the work is to be done this year.

Utica, N. Y.—Notice is hereby given that sealed proposals will be received for the electric lighting of the streets and public buildings in the city of Utica, according to the plans and specifications on file in the office of the city clerk of said city.

NEW CORPORATIONS.

Portland, Me.—The Farmington Electric Light Co. has been incorporated with a capital stock of $10,000, of which nothing has been paid in. President, E. S. Dingley, of Farmington; Treasurer, J. P. Flint, of Farmington. To generate and distribute gas and electricity for light and power.

Newark, N. J.—The Consumers' Electric Light and Power Co. Capital, $300,000. The company will produce and furnish electric light and power in Newark and elsewhere. Incorporators: Benjamin Atha, Albert O. Headley, Edward L. Conklin, of Newark.

McKeesport, Pa.—A company composed of local men will erect an incandescent electric lamp factory in this city. Work will be begun Aug. 1. The projectors of the new works are C. W. Egers and W. W. Brodie. New factory will have a capital of $50,000, and capacity of 5,000 lamps per day.

Baltimore, Md.—The Baltimore, Gardenville and Belair Electric Railway Co., incorporated to construct an electric railway on the Belair turnpike.

Buffalo, N. Y.—The Ellicott Manufacturing Co. has been incorporated with a capital stock of $35,000. The company will manufacture and sell electrical apparatus, supplies, etc.

Harrisburg, Pa.—A charter has been granted to the Elizabeth Electric Light, Heat and Power Co., of Elizabethtown; capital stock, $9,000.

New York City, N. Y.—The U. S. and Hayti Telegraph and Cable Co. has been incorporated with a capital stock of $1,800,000. Directors: John W. Mackay, C. Clapperton, Albert Bick, John Beattie, C. E. Merritt, A. B. Chandler and E. C. Platt.

The Electric Tool Co. has been incorporated; capital stock, $100,000. Directors: Frank Heath, A. M. Johnston, L. A. Smith, C. E. Fennessey, of New York, and Stanley Cunningham, of Boston.

Columbia, S. C.—A commission for a charter has been issued to the Columbia and Eau Claire Electric Railway Co. Capital, $50,000. Incorporators: F. H. Hyatt, Chas. W. McCreery, W. A. Clark and J. S. Miller.

NEW TELEPHONE COMPANIES.

Gloversville, N. Y.—The Northern Telegraph and Telephone Co. has been incorporated with a capital stock of $30,000. The company will have lines in the counties of St. Lawrence, Jefferson, Hamilton, Franklin, Oneida and Onondaga.

Philadelphia, Pa.—The North and West Branch Telephone Co., of Sunbury, has been incorporated with a capital stock of $50,000.

Scranton, Pa.—The Franklin County Telephone Co. has been chartered, with the capital stock placed at $1,000.

Davenport, Ia.—The American Telephone and Telegraph Co. Capital, $15,000. Incorporators: Edward J. Hall, Edward P Meany and Melville Eggleston.

TELEPHONE NOTES.

Effingham, N. H.—Effingham is to have telephone connection.

Fountain City, Minn.—Paul Huefner, of Fountain City, will soon erect a new telephone line from Fountain City to the Eagle Mills.

Argyle, N. Y.—The North Argyle Union Telephone Company will extend their line to Salem, via county house and South Argyle.

Columbus, O.—A movement is on foot to construct a telephone line from here to Sycamore, to connect the independent exchanges in the two towns.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued June 23, 1896.

562,365. Alternating-Current Motor. Engelbert Arnold, Zurich, Switzerland. Original application filed Jan. 11, 1893. Divided and this application filed July 10, 1894. Patented in England Dec. 17, 1892, No. 23,290; in Switzerland, Dec. 24, 1892, No. 6,306, and in Germany Jan. 1, 1893, No. 74,684.

562,366. Electric Motor and Dynamo. Engelbert Arnold, Carlsruhe, Germany. Filed Apr. 5, 1895.

562,395. Electric Cigar-Lighter. Augustus C. Gruhlke, Waterloo, and William F. Kessler, Auburn, Ind.; said Gruhlke assignor to said Kessler. Filed Dec. 6, 1895.

562,396. Secondary Battery. Robert J. Gulcher, Charlottenburg, Germany. Filed Feb. 29, 1896.

562,398. Electric Locomotive. John C. Henry, Westfield, N. J. Filed April 22, 1895.

562,400. Electric Furnace. William R. King and Francis Wyatt, New York, N. Y. Filed Jan. 24, 1896.

562,403. Electric Furnace. William R. King and Francis Wyatt, New York, N. Y. Filed Apr. 21, 1896.

562,404. Electric Furnace. William R. King, New York, N. Y. Filed Feb. 1, 1896.

562,429. Electrical Advertising Apparatus. Charles E. Skinner, Pittsburg, Pa. Filed Feb. 28, 1894.

562,431. Electrical Releasing Device. Chas. A. Stearns, Watertown, Mass. Filed Apr. 15, 1896.

562,453. Electric Railway. Henry Brandenburg, Chicago, Ill. Filed Mar. 11, 1895.

562,457. Car-Fender. William Christian, East Orange, N. J., assignor of one-third to Isaac Gaston, Newark, N. J. Filed Oct. 7, 1895.

562,463. Automatic Relief-Valve for Electric Pumps. Milan W. Hall, Plainfield, N. J., assignor to the Otis Brothers & Company, New York, N. Y. Filed Oct. 20, 1893.

562,477. Car-Fender. Louis L. Mincer, Rochester, N. Y., assignor of three-fourths to Henry Michaels, R. Soble and Sol Savage, same place. Filed Dec. 12, 1895.

562,483. Traveling Contact or Plow for Underground Electric Railways. Samuel L. Phillips, Washington, D. C. Filed Jan. 21, 1896.

562,484. Traveling Contact for Underground Electric Railways. Samuel L. Phillips, Washington, D.C. Filed Jan. 21, 1896.

562,494. Trolley. Henry A. Seymour, Washington, D. C., assignor to the General Electric Company, of New York, N. Y. Filed Feb. 20, 1896.

562,499. Coupling for Electric or Other Power Transmission. Elmer A. Sperry, Cleveland, O., assignor, by mesne assignments, to the General Electric Company, of New York. Filed July 3, 1894.

562,501. Elctric Controller. Elmer A. Sperry, Cleveland, O., assignor to the General Electric Company, of New York. Filed Feb. 20, 1895.

562,502. Electric Locomotive. Imle E. Storey, Boulder, Colo., assignor to the Storey Electric Drill and Power Company, of Colorado. Filed June 29, 1892.

562,523. Trolley Device. Hiram A. Gray, New Haven, Conn. Filed Aug. 1, 1895. Renewed Apr. 27, 1896.

562,527. Rheostat or Electric Heater. William S. Hadaway, Jr., New York, N. Y., and William E. Davis, Malden, Mass., assignors to the Central Electric Heating Company, New York, N. Y. Filed July 18, 1895.

562,541. Automatic Operation of Electric Generators. Frank E. Kinsman, Plainfield, N. J. Filed June 23, 1893.

562,564. Bank of Electromagnets. Charles E. Allen, Salem, Mass., assignor to the Stenotype Company, Portland, Me. Filed Oct. 28, 1895.

562,591. Apparatus for Operating Trolley-Arms. Patrick J. Dowling, Waterbury, Conn., assignor of one-half to Arthur O. Shepardson, same place. Filed July 23, 1895.

562,607. Electric-Locomotive Truck. William P. Henszey, Philadelphia, Pa. Filed Oct. 4, 1895.

562,609. Electric-Arc Lamp. Daniel Higham, Boston, Mass. Filed Mar. 31, 1896.

562,647. System of Electrical Distribution. Louis K. Oppenheimer, Cincinnati, O. Filed Dec. 21, 1895.

562,658. Electric Switchboard and Circuit-Maker. Arthur L. Pratt, Kalamazoo, Mich. Filed Apr. 9, 1896.

562,673. Electric Igniter for Gas or Hydrocarbon Engines. Frank M. Spaulding, Kalamazoo, Mich., assignor of one-third to H. C. King, Three Rivers, Mich. Filed Sept. 9, 1895.

562,680. Electric Meter. Addison G. Waterhouse, Hartford, Conn. Filed Mar. 25, 1895.

562,686. Alternating-Current Motor. Merle J. Wightman, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 26, 1888.

562,745. Controlling Mechanism for Electric Motors. Rudolph C. Smith, Yonkers, N. Y., assignor by mesne assignments, to the National Company, Chicago, Ill. Filed Jan. 25, 1892.

562,765. Medical Electrode. William P. Horton, Jr., Cleveland, O., assignor to William P. Horton, same place. Filed Dec. 30, 1895.

562,766. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to The Electric Car Company of America, same place. Original application filed Sept. 23, 1886.

562,769. Street-Car Fender. Anton Knoblauch, Minneapolis, Minn. Filed Oct. 5, 1895.

562,775. Electric Lighter. Herbert E. Rider, Brooklyn, N. Y., assignor to Robert W. Inman, New York, N. Y. Filed May 2, 1895.

The Electrical Age.

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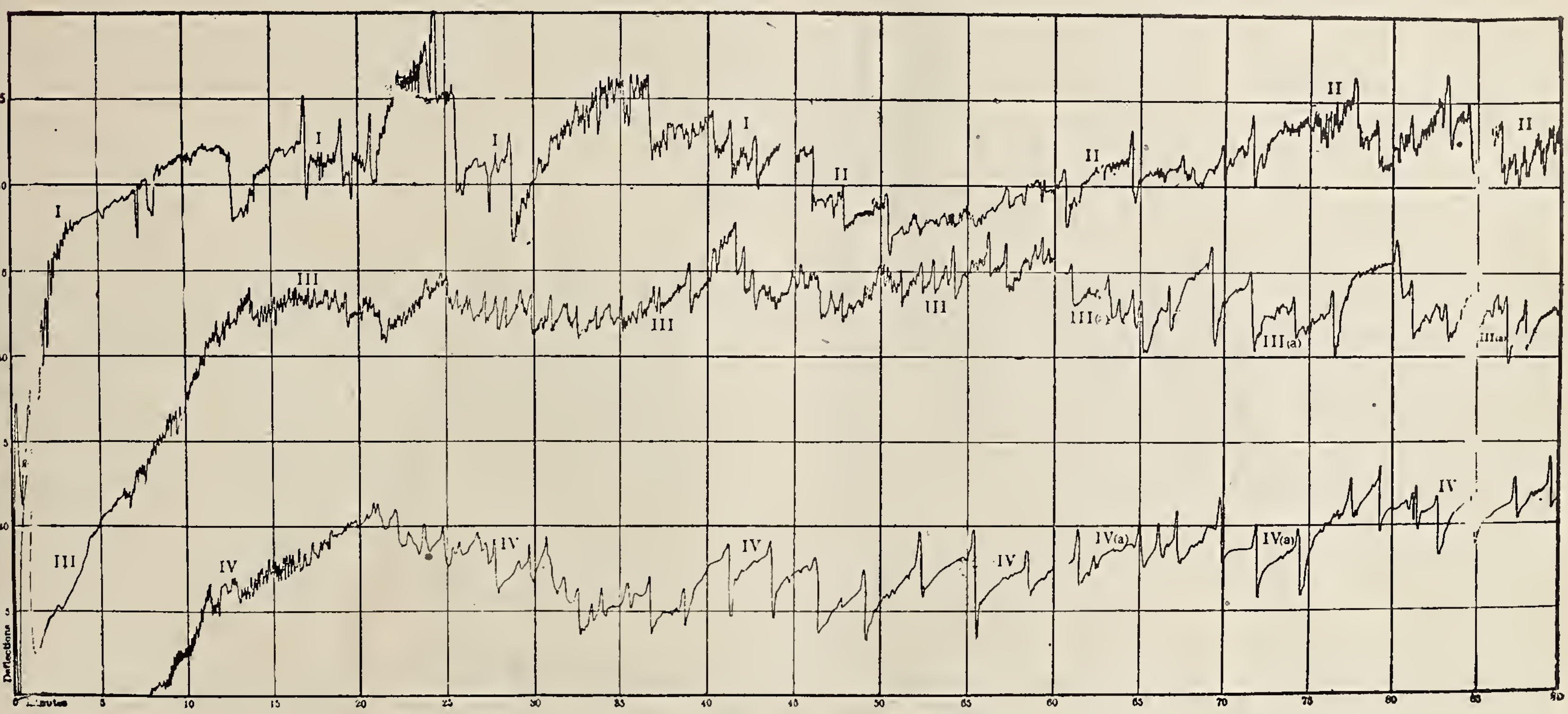


Fig. 3.

STANDARDS OF LIGHT.*

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

BY EDWARD L. NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

NE of the sub-committees appointed in 1893 to investigate the subject of a suitable standard of light for photometric purposes has been engaged upon preliminary experiments, and upon the collection of data concerning the existing standards, and also of such other sources of light as might be regarded as possible substitutes for the standards now in use. Such investigation is a necessary preparation for the consideration of recommendations looking to the adoption of any new standard.

The committee is still at work upon these preliminary experiments, but it has reached a stage when it seems desirable to make the following report of progress:

I.

The following sources of light have been in use in photometric work for a sufficient length of time to enable various observers to become acquainted with their merits and likewise with their imperfections:

(1) The Carcel Lamp.
(2) The British Standard Candle.
(3) The German Standard Candle (Vereinskerze).
(4) The Methven Screen.
(5) The Hefner-Alteneck Amyl-acetate Lamp.
(6) The Harcourt Pentane Standard.
(7) The Harcourt Pentane Lamp.

In addition to these, the Violle platinum standard of light has been before the scientific public for several years and although it has not gone into extensive practical use, it has been subjected to severe tests in the laboratory of the German Imperial Institute for Research (Reichsanstalt in Charlottenburg) and elsewhere. Various luminous gas flames, also incandescent lamps, have been extensively used as secondary standards. The following standards have likewise been proposed, and a certain amount of work has been done to demonstrate their good properties and to determine the degree of accuracy with which they can be reproduced:

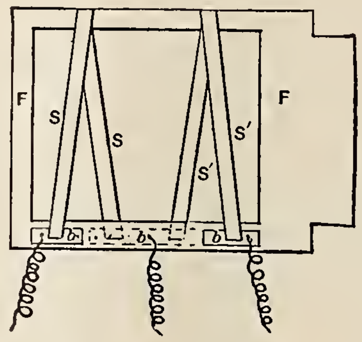
(1) The crater of the positive carbon in the arc.
(2) The surface of a strip of platinum heated by means of a current to an arbitrarily defined temperature.

Finally, there are a number of light sources which must be taken into account in the selection of a standard of light, aside from those which have been mentioned in the above list. Such are gas flames burning within a mantle of pure oxygen (the Bude Light), the acetylene flames, the various incandescent mantle burners, the light from other glowing metallic oxides, such as the zircon light and the light of burning magnesium.

The committee proposes to present in this report a

*A report presented to the General Meeting of the American Institute of Electrical Engineers, New York, May 20, 1896.

summary of measurements, which have been made upon the various sources of light mentioned above, with a view to reaching some decision with reference to their relative merits as light standards. It is hoped thus to pave the way for experiments leading to the recommendation of new definitions of the standard of light, or at least to the recommendation of greatly improved procedure in the handling of existing standards.



In the case of many of these sources of light, the members of the committee have made extensive measurements of their own, either in the verification of existing statements, or in the exploration of questions hitherto not definitely attacked. It is proposed in this report to give a brief resumé of these experiments, some of the results of which have already appeared elsewhere, and to summarize the existing work of previous investigators, so far as the committee is acquainted with the same.

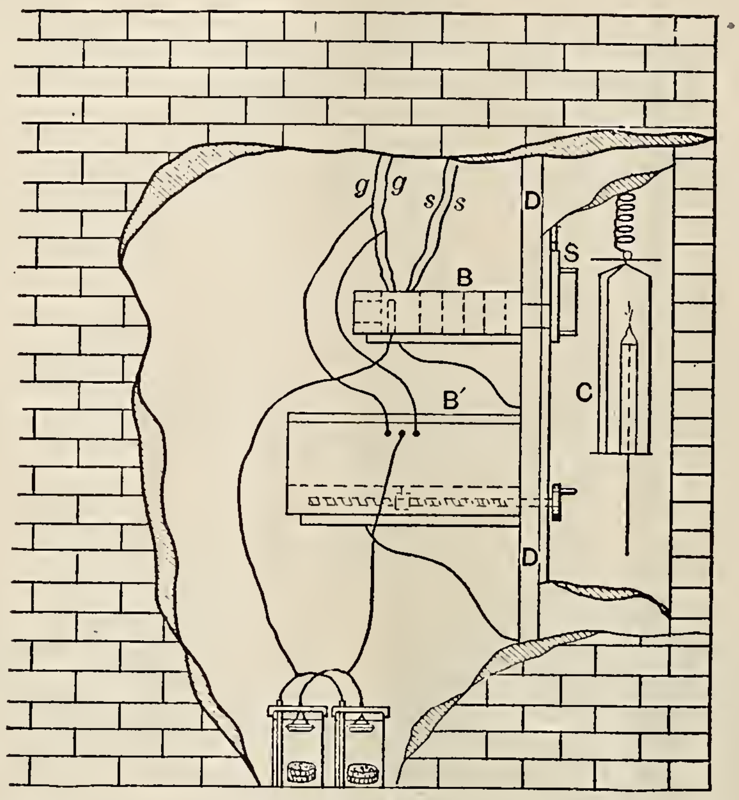


Fig. 2.

II.

Tests of standards of light belong to one of two general classes; in the first class are included all comparisons of flames with flames, the results of the tests being in this case affected by the change of the standard flame with the purity, temperature, and hygrometric state of the atmosphere. They show in general only the variations of the standard in question which take place during short periods of time, and demonstrate nothing concerning the variations which take place from day to day. In the second class are included all comparisons of light standards with glow lamps and also bolometer tests.

TESTS OF BRITISH STANDARD CANDLES.

The British standard candles were specified by act of Parliament, in 1860, to be sperm candles weighing six to the pound, and burning 120 grains per hour. In spite of universal condemnation by all who have tested this standard, it still maintains its position in Great Britain and America.

Messrs. Harcourt, Keats and Methven, appointed by a committee of the Board of Trade to investigate the performance of British candles, found a difference of 15% in the average illuminating power of legal candles, while two pairs showed a maximum variation of 22.7%.

Heisch and Hartley, acting for the committee on light standards of the Council of the Gas Institute, found that the differences in the illuminating power of candles ranged from 1.3 to 16%, the average difference being 7.05%. They also reached the conclusion that sperm candles developed more light per grain of sperm consumed than they had done several years before.

Dibdin conducted two long series of experiments with various standards, reporting the results of the tests to the Metropolitan Board of Works. He compared the standards with the flame produced by a specially stored coal-gas. His tests were very extensive, and his reports voluminous and exhaustive. For the British candle he found in his first series of tests a maximum variation of 14.9%, which occurred twice, and a maximum total variation in a single group of 23.2% which also occurred twice. The mean variation, disregarding signs, was 3.6%. Variations of from 5 to 8% were common; 13.7% of the tests were within 1% of the mean. In the second series the maximum variation was 11.7%, and the maximum total for one group 19.3%. The mean variation was smaller on account of the fewer observations in each group. This may account for the fact that in this series 34% were withing 1% of the mean.

In his next report he combats the view of Heisch and Hartley that candles gave more light per grain of sperm then, than they had given several years before. Comparing determinations of the candle power of the Carcel lamp, made in 1870, with other made in 1879, he found

that the illuminating power of candles had decreased rather than increased during these nine years.

A committee of the British Association, comprising numerous distinguished members of that body, in their fourth report rendered at the Plymouth meeting in 1888, gave the results of extensive tests of candles. Their comparison standard was a burner supplied with coal-gas which had been enriched with pentane. Of 118 experiments, 98 gave differences of 1% from the mean, 57 gave differences of 2%, 19 of 5%, while differences of 9 to 10% were produced only very irregularly. They concluded that candles are not worthy to be called standards, although they conform to the legal requirements, and that the intensity of their light is affected by the purity of the air in the room, the shape and construction of the wick, the nature of the sperm and by other causes.

They also pointed out that the spermaceti is not a substance of definite chemical composition; that improvements in the process of manufacturing have resulted in what is known as a "dryer" sperm, one containing less oil; that to prevent crystallization, a variable quantity of beeswax is added. They inferred from these considerations that it is probably true that the illuminating power of candles has changed since the quality of sperm employed, the construction of the wick with respect to the number of strands, the tightness of the twist, etc., are not specified in the act, but are left to the option of the makers. This committee regarded as the chief source of the oscillations of the light:

(1) Changes in the length and shape of the wick.

(2) Difference in the height of the melted sperm in the cup of the candle.

Photometric observations by the many other observers have simply served to confirm the above conclusions. A recent Dutch commission, for example[1], found, from many tests, the mean fluctuation in the intensity of British standard candles to be $\pm$ 2.43%, with a maximum of 9.70%.

Methven has shown the following variations in the intensity of a candle to take place with changes in the azimuth of the plane of the wick. Two candles were used, their intensities being as follows:

Plane of the wicks perpendicular to bar, c. p. equals 1.999.

Wicks pointing away from the photometer, c. p. equals 1.933.

Wicks pointing towards the photometer, c. p. equals 1.957.

He found also that a candle which gave in dry air an intensity of 1.104, gave in moist air an intensity of 1.196,—a variation of 8.38%.[2]

1. For an abstract by Krus, see *Journal fur Gas Beleuchtung und Wasserversorgung* (1894).
2. John Methven: *Dingler's Polytechnisches Journal*, vol. 277, p. 276, taken from London *Gas World*, 1889, p. 572. See also Sugg: *Journal for Gas Lighting*, which is reprinted in the *Scientific American Supplement*, *No.* 484, p. 7726.

BOLOMETRIC MEASUREMENT.[3]

The extraordinary fluctuations of such sources as the British candle make photometric measurements difficult and uncertain. The consideration of the discrepancies exhibited in the results of previous observers suggested to the members of your committee the substitution of the bolometer for the eye, in the study of such sources of light. The following is a summary of the investigation which resulted from this suggestion:

DESCRIPTION OF APPARATUS.

A piece of Swedish iron wire, of No. 30 B. & S. gauge, was passed through jeweler's rollers until its thickness was about 0.045 mm. and its width 1.5 mm. It was then placed in dilute sulphuric acid, in which potassium bichromate had been dissolved, and a current was passed through it in such a manner as to dissolve the iron. The potassium bichromate was introduced into the solution to dispose of the hydrogen bubbles which would ordinarily have clung to the metallic surface, and which would have caused it to be dissolved unevenly.

In this way the strip was obtained which was about 0.025 mm. in thickness and still moderately strong. From this strip were cut out two pieces, each about 6 cm. in length, to constitute two arms of a Wheatstone bridge.

To carry the strips so obtained, a light oblong frame, F (Fig. 1), of thin wood was made, and to it were fastened small bits of sheet brass, *b*, *b*, *b*, to which the strips and the copper wires intended to connect them with the other arms of the bridge could be soldered. The strips, S, S′, were then bent and placed over the frame, so that each strip crosed the frame twice. The free ends of each strip were displaced laterally from each other, so that, when viewed from the front, the portion of the strip on one side of the frame hid only very little of the portion on the other side of the frame.

After the two strips had been arranged on the frame symmetrically with respect to each other, the one which was to receive radiations was carefully smoked on both sides. To accomplish this smoking without undue heating of the strip, a piece of sheet metal, through which a small hole had been punched, was held over a candle flame so that the flame was caused to smoke. The smoke passed through the hole, over which a tube was held to direct the current. The strip was passed back and forth over the top of the tube. In this way a very delicate strip can be blackened without injury. In their completed state, the strips had a resistance of about 0.5 ohm each.

(To be continued.)

TABLE I.

BOLOMETRIC MEASUREMENTS OF THE BRITISH CANDLE.
(DATA FOR CORRECTIONS OF THE CURVES)

Number of curve.	Times of taking zero and sensitiveness readings.		Time of lighting.	Time of taking the curve.		Hourly rate of consumption.	Distance from bolometer.	Initial sensitiveness.	Correction for		Reduction of standard		
									Drift.	Change of sensitiveness.	Sensitiveness.	Distance.	Rate.
	h. m.	h. m.	h. m.	h. m.	h. m.	grams.	c.m.						
I.	8 47 and	10 01	8 50	8 50 to	9 35	7 910	25.3	16.2	+0.9	+0.2	0	—2.3	—0.70
II.	9 41	10 50	9 33	9 50	10 35	7.767	26 0	16.1	—0.4	0	+0 3	0	+0.05
III.	8 00	9 15	8 00	8 00	9 00	7.842	26.0	16.1	—2 9	+0 8	+0.3	0	—0 34
III. (*a*)	9 38	10 30	8 00	9 45	10 15	7.842	26.0	16.08	+0.3	0	+0.3	0	—0.34
IV.	7 50	9 05	7 50	7 50	8 50	7.692	25 3	16.15	+1.0	—0.1	+0.1	—2.1	+0.45
IV. (*a*)	9 35	10 30	7 50	9 45	10 15	7 692	25.3	16.4	—0.1	0	—0 5	—2.3	+0.45

Kensington, Pa.—Kensington will hold an election August 29 to vote on the question of issuing $20,000 in bonds for the electric light plant and other improvements.

3. For a more detailed description of these measurements, see Sharp and Turnbull, *Physical Review*, vol. ii, p. 1.

ANALYSIS OF TRANSFORMER CURVES.

(Continued from Page 409.)

Figs. 4, 5, 6 give the magnetizing current curves for sinoidal flux curves, for B_{max}, 1360, 3720, and 5830, respectively, derived from these loops in the manner above described, with additional curves derived by analysis of the first.

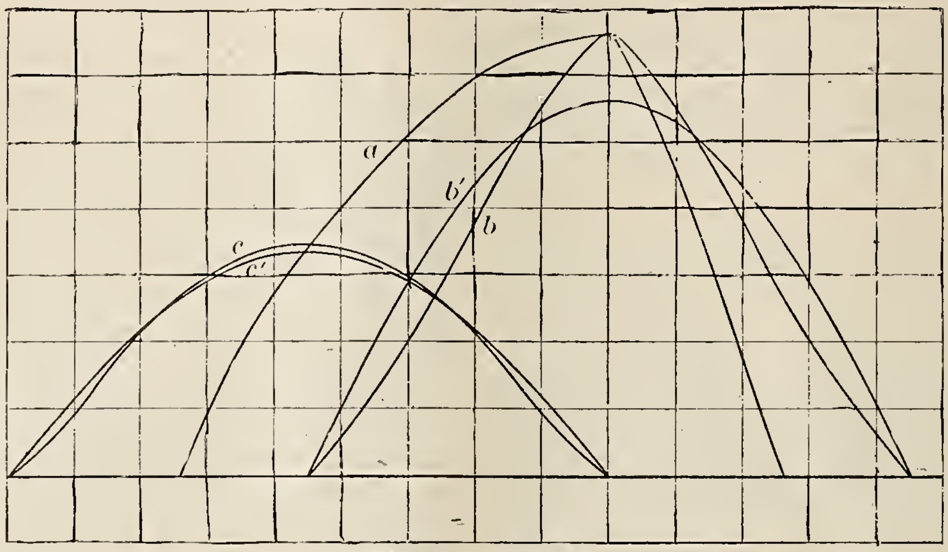


Fig. 4.—B = 1360.

In Fig. 4, for the lower range, 1360, the approximation is very close, but *c* is slightly more *pointed* than the sine.

In Fig. 6, for the higher range 5830, the approximation is not quite so close, but *c* is more *flattened* than the sine.

These approximations are quite close, but it is easy to determine the exact form of hysteretic characteristic necessary for a sinoidal hysteretic current, when the flux curve is sinoidal.

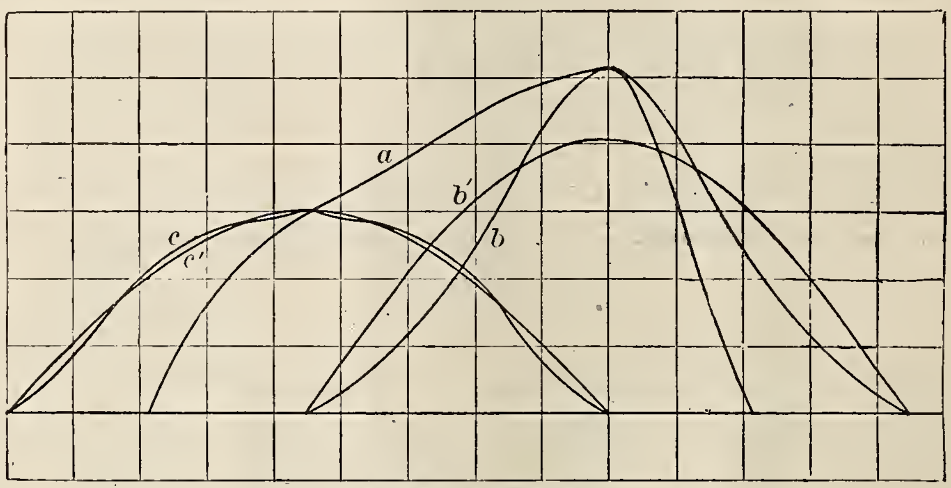


Fig. 5.—B = 3720.

Let E and M (Fig. 7.) be sinoidal E. M. F. and flux curves, respectively, drawn to same size for convenience.

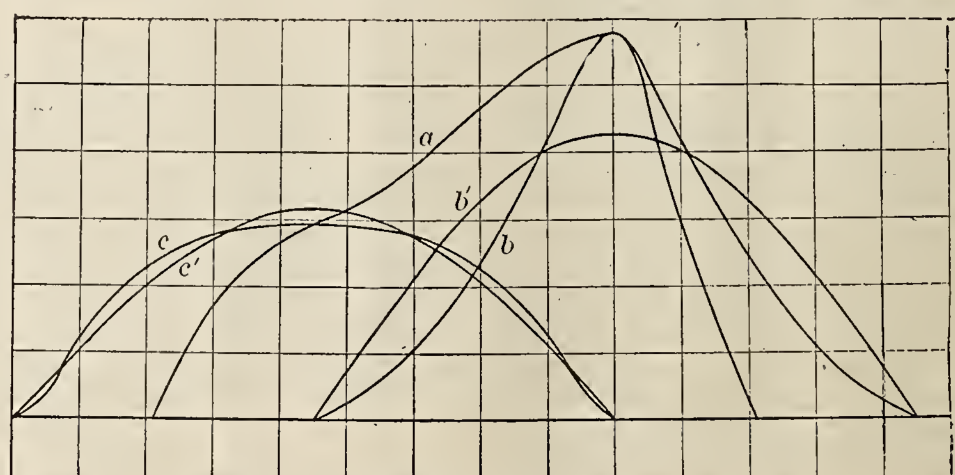


Fig. 6.—B = 5830.

Assume the hysteretic current due to a simple resistance, *i. e.*, $H = \frac{E}{R}$ (instantaneous values). Then plot a curve between the flux value at each successive epoch and the hypothetical hysteretic current at that epoch.

A hysteretic characteristic of the form thus determined will obviously satisfy the conditions.

This curve is the quadrant of an ellipse.

For $E^2 + M^2 = A^2$, where $A = E_{max.} = M_{max.}$ But $H = \frac{E}{R}$ by assumption, whence $H^2 R^2 + M^2 = A^2$, which is an ellipse, H and M being the variables.

For our purposes the quadrant tells the whole story, so that we may say that the assumption, for sinoidal E. M. F., of hysteresis as due to a simple resistance, is absolutely correct when the hysteretic characteristic is a quadrant of an ellipse.

If we compare this ideal curve with the hysteretic characteristics for the ranges used in Figs. 3, 4, 5, plotting each characteristic to a horizontal scale proportioned to the virtual value of its hysteretic current, as indicated by its equivalent sine, we see the same manner and degree of approximation as in the cyclic curves. The ellipse is intersected by horizontal bars indicating the successive epochs in the cyclic curve, and by reference to these it is

seen that each characteristic intersects the ellipse at a point corresponding exactly to the intersection of the cyclic hysteretic current by its equivalent sine, and that the relationship is in every respect identical.

A glance at the hysteretic characteristics in Fig. 3 shows that for ranges higher than 5830, the hysteretic current curve will not only be more flattened, but actually depressed in the middle. But while the increased distortion of the hysteretic current will introduce higher harmonics, yet the rapid diminution in the permeability on approaching saturation will introduce them much more rapidly with increase of the range, so that the distorting influence of the hysteretic current will be comparatively slight even at the higher ranges. At the highest ranges, as the one given by Steinmetz[1], mentioned above, B = 16,000 the inordinate peak of the wattless magnetizing current throws into oblivion higher harmonics from any other source.

To conclude; for sinoidal E. M. F.:

(1) Hysteresis may in all respects be replaced by a constant resistance if the hysteretic characteristic be the quadrant of an ellipse.

(2) This condition is approximately satisfied for moderate ranges of magnetization (such as are used in practice,) in reasonably good iron, and the higher harmonics are negligible. There will usually be a particular range that will give a nearly perfect approximation. On contraction of the range, the hysteretic current becomes more pointed than the sine, and on expansion beyond the critical range, more flattened than the sine.

(3) The increased distortion of the hysteretic current for higher ranges will cause an increase in the higher harmonics, but the rapid diminution in the permeability on approaching saturation will cause a much greater increase in these harmonics, so that even at higher ranges the distorting influence of hysteresis is comparatively slight.

1. TRANSACTIONS, vol. xi., p. 719.

As a final conclusion, then, we may say that Prof. Rowland's hypothesis that the higher harmonics in the transformer for sinoidal E. M. F. are due, not to hysteresis, but to variation in permeability, and that the effect of hysteresis may be represented by a constant resistance, is approximately correct, for reasonably good iron, is very nearly correct for the moderate ranges used in practice, and may, under certain conditions, be absolutely correct.

A study of hysteretic characteristics would, no doubt, shed some light on the phenomena of magnetism, but it is beyond the scope of this paper.

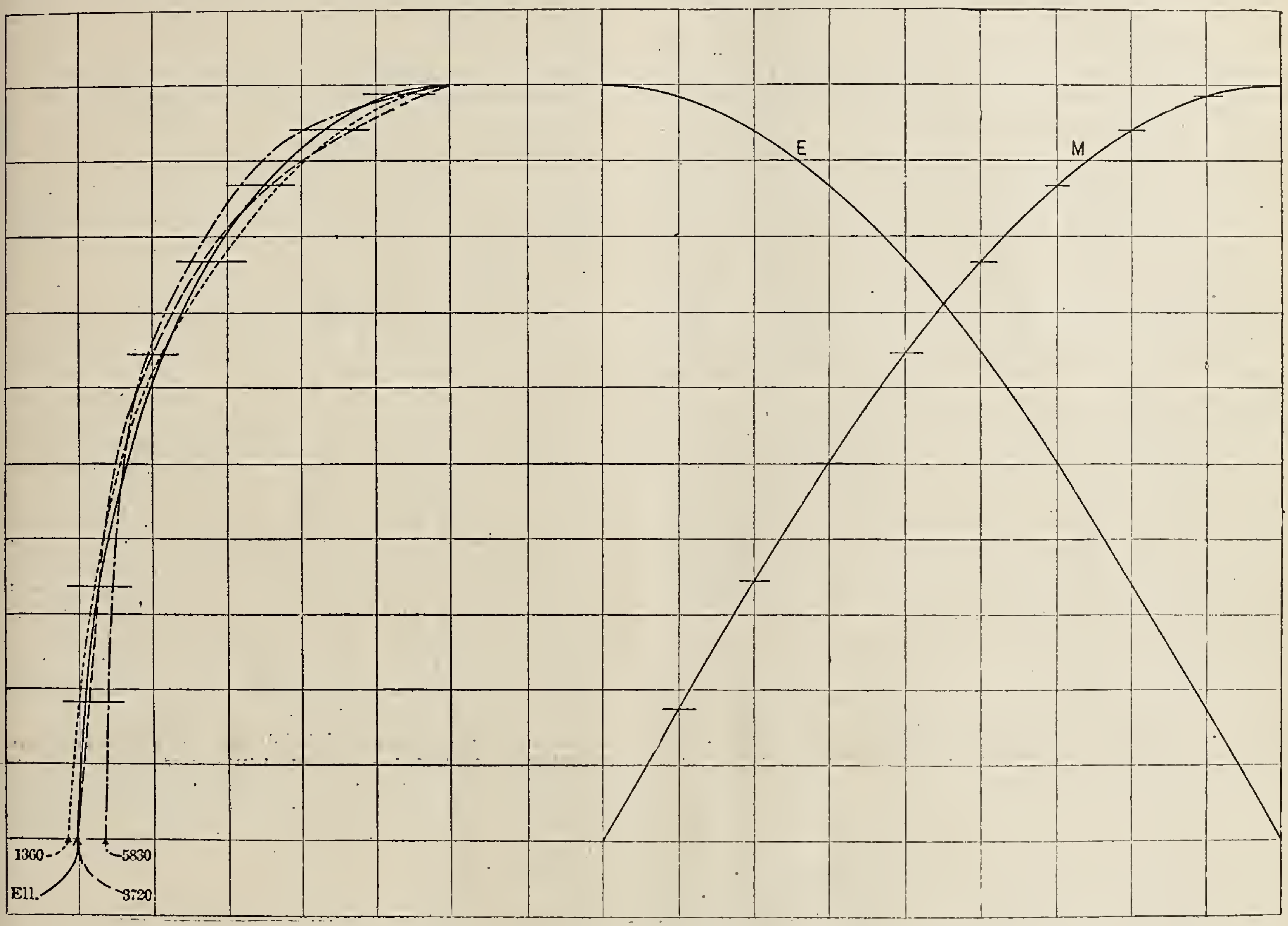


FIG. 7.

IRIDIUM.

Is a white brittle metal, fusible with great difficulty before the oxyhydrogen blow-pipe. Deville and Debray, by means of their powerful oxyhydrogen blast furnace, have fused it completely into a pure white mass resembling polished steel, brittle in the cold, somewhat malleable at a red heat, and having a density equal to that of platinum.

A complete and practical series of tables, the work of Thos. J. Fay, E. E., will be ready for sale next week. They cover all wiring problems, including—

Distances from 10 to 1,000 ft.,
Size of wire No. 14 to 1,000,000 C. M.,
Losses from 1 to 100 volts,
Current from 1 to 1,000 amperes,
The resistance, safe carrying capacity, weight, etc.

Mr. Fay's experience has been very broad and his tabulated forms are immediately applicable to numerous cases. There are also additional tables on electric pumps and elevators, in a very convenient form. The practical nature and ready applicability of these tables make them far superior to anything published. Price complete, one dollar.

OBITUARY.

Mr. Abraham L. Bogart, the noted manufacturing electrician of 22 Union Square, N. Y., fell dead into the arms of his son, A. Livingston Bogart, Saturday afternoon at 5.30 o'clock.

Mr. Bogart was left an orphan at the age of thirteen, with two brothers to support. He began as an errand boy for a dry goods house on Broadway, and in a few years owned the business. He was the first to put up fine-cut chewing tobacco in tin-foil, and also the first one to build smokestacks for locomotives. After this he introduced dry gas meters; also gasoline and gas stoves for heating, cooking, etc. He was an expert gas engineer, setting up photometric apparatus for gas companies. In 1867 he started in the electrical business, introducing the multiple gas lighting apparatus for churches, theatres, etc. Following this he patented sixty inventions for electric gas lighting apparatus. The leading theatres, churches, halls, etc., of the United States still use his inventions for lighting gas by electricity. His business continued to branch out extensively, keeping pace with the demands in electric lighting and household supplies. He was well known as a fighter for his rights under his patents, and was one of the few patent litigators who fought successfully, for he always came out of his litigations with more money than when he began them.

Mr. Bogart left his office at 12'clock noon, Saturday, July 25; met his son, A. Livingston Bogart, and proposed a ride on their wheels. Starting together, at 5.30, they had ridden between two and three miles, when both dismounted on a bridge over a stream. They were quietly talking together when, without any previous complaint of either fatigue or illness, and in the midst of the conversation, Mr. Bogart suddenly groaned and expired in the arms of his son.

Mr. Bogart was born Nov. 20, 1818, and had never been ill, to the knowledge of his family. He never complained of pain, excepting from falls in accidents; was very temperate in all his habits, and one of the most vigorous of men for his age.

The last thing he did in business was to procure a contract at 12 o'clock on the day of his death. He left three children by his first wife, two sons and one daughter, all adults; two children by his second wife, the oldest eight years. He died intestate. His sons, A. Livingston Bogart and Eugene E. Bogart, have always been associated with him in the electrical business, and it is expected they will continue it under the same firm name of A. L. Bogart. A. Livingston Bogart is a well-known expert and electrical and mechanical engineer, and Eugene has always looked after the books and finances. Both are known to have been devoted sons.

It is reported that a big combine has been formed to maintain the price of incandescent lamps, by the leading manufacturers in the United States. This new arrangement is expected to go into foree Monday, August 3, and will practically put an end to the war of prices which has virtually done away with all the profits in this line of business. The factories and corporations under the new combine are: The General Electric, the Bryan-Marsh Co., Columbia, Packard, Westinghouse, Buckeye, Sunbeam, Adams-Baggnall, Perkins, Burnstein and Beacon.

Waukesha, Wis.—The National Telephone Construction Co., which has been operating a telephone exchange at Waukesha, has ceased business. The exchange was built a few months ago to compete with the Wisconsin Telephone Co., but it was found impossible to give satisfactory service with the instruments used, or a service that would bear comparison with that furnished by the older company.

CARBON-CONSUMING BATTERIES.

It will be remembered that some time ago Dr. Coehn obtained what he believed to be a true solution of carbon in hot sulphuric acid, and proceeded to investigate the question whether a carbon-consuming cell could not be obtained in this manner. Dr. Coehn used lead peroxide on the other plate, but the results obtained have been subjected to serious criticism. To some of these criticisms Dr. Coehn has replied in the "Zeitschrift für Electrochemie. Part of this is concerned in what really happens when an element passes into solution, and has only an inferential bearing on the practical question. Prof. Mendelejeff is quoted as stating that with a weak current through a liquid compound of chlorine and carbon powdered diamond is deposited on the negative electrode, but it is thought that he referred to the work of Despretz; who obtained a diamond powder on a platinum electrode by passing a weak current for two months through acidulated water. He also obtained green crystals on the positive pole by a weak current for six months through an alcoholic solution of a compound of chlorine and carbon, while on the negative pole there was a brown warty substance having the same hardness as diamond. It is also stated that traces of carbon are sometimes contained in the deposited metals in an electrolytic bath. All this, however, only shows what a very long way Dr. Coehn is at present off a practical solution of the problem. With reference to the Jacques hot soda cell, little further has been heard of it except that a company has been or is to be formed to exploit the invention. The American criticisms of it run on the obvious lines, and do not appear to be based on any closer acquaintance with the battery than the descriptions that have appeared from time to time. Of course the first question to determine is whether it is merely necessary to get the soda to a high temperature in order to secure the desired reaction or whether heat is continuously absorbed from the furnace. The arrangement as it at present stands is obviously capable of improvement should the first supposition turn out correct. —London Electrical Engineer.

A 5-pound meteorite which fell last April in an orchard near Namur, in Belgium, nearly killing a young man who was digging there, has been examined at the university laboratory at Ghent. It consists of a whitish crystalline paste, containing iron, troilite, olivine, bronzite, etc.—Industrial World.

Among the results arrived at by the committee appointed by the American Association of Railway Superintendents, for the purpose of considering the strength of timbers for bridges and trestles, emphasis is laid on the fact that variation in strength are generally directly proportionally to the density or weight of the timber, and that structures should be, in general, designed for the strength of green, or moderately seasoned timber, of average quality, and not for a high grade of well-seasoned material, age or use not destroying the strength of timber unless decay or season checking takes place. It is found that timber, unlike materials of a more homogeneous nature, as iron or steel, has no well-defined limit of elasticity; for, as a rule, it can be strained very near to the breaking point without serious injury, which accounts for the continuous use of many timber structures with the material strained far beyond the usually accepted safe limits; while, on the other hand, sudden and frequently inexplicable failures of individual sticks at very low limits are liable to occur. Knots, even when sound and tight, are declared to be one of the most objectionable features of timber, whether for beams or struts. The full-sized tests demonstrate, not only that beams break at knots, but that invariably timber struts will fail, owing to the proximity of a knot, by reducing the effective area of the stick, and causing curly and cross-grained fibers.—Tradesman.

Tamworth, N. H.—An electric railroad is projected from Tamworth to West Ossipee.

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CONTENTS.

	PAGE
EDITORIALS	
The Alternator	427
Electricity from Heat	427
GENERAL SUBJECTS	
The Standards of Light	421
Analysis of Transformer Curves	424
Electro-Magnetic Induction	428
EXTRACTS	
Roentgen Rays	429
Interesting Facts in Science	430
OBITUARY	426
MISCELLANEOUS	
Carbon-Consuming Batteries	426
Telephone *vs.* Trolley	430
A Volatile Solvent for Cotton	430
TRADE NOTES	
Gould's Pumps	431
New York as a Summer Re ort	430
Possible Contracts	435
Telephone Notes	435
NEW CORPORATIONS	435
New Telephone Companies	435
PATENTS	436
Telephone Patents	435

THE ALTERNATOR.

Some departments of engineering are older and still less developed than others. While this may be due to a lack of interest in that branch, it is frequently caused by the absence of a mind which combines synthetic qualities with an analytical power. That this is the case may be proven by the labors of Tesla, Dobrowolosky and Ferranti.

For many years the alternator, with its hidden stores of latent applications, its great possibilities for the transmission of power and its unique features of distribution for municipal lighting, were undeveloped fields of science and engineering. It is extremely hard to see the tree in the tiny kernel, and harder still to pursue with confidence a line of investigation that is self-encouraged, self-sustained and possibly the outcome of mere hope and expectation. This, then, is the work the builders of a huge system of light, power and distribution have cut out for themselves and persistently followed. They have seen its dark beginnings, its refuted truths, its conservative and sluggish followers hypnotized into believing its great practical applications by their force and argument and deep-seated enthusiasm. They have passed through the war of criticism and moved unbewildered and unharmed. To the alternator, the emblem of genius and invention are forever attached the names of great men. Probably more efforts have been made at this period to bring it into general use than any machine known. Its exponents see no limit to its application, and indeed, blessed as they are now with a long-wished-for joy—a self-starting motor—the boundaries drawn may not be the unlimited circle of an inventor's dream.

ELECTRICITY FROM HEAT.

The interest once displayed in the construction of thermo-electric apparatus has practically expired. When Seebeck in 1820 discovered the principle that "when one of the junctions of a closed circuit of two metals is raised to a higher temperature than the other, a current of electricity passes round the circuit and (in general) increases its intensity with increasing difference of temperature of the junctions. The direction of the current is, of course, reversed if the cold junction be now made the hotter," an unusual excitement was manifested in scientific circles. The great future of thermo-electric apparatus was pictured by many an ardent advocate. Unfortunately these enthusiastic demonstrations were without avail; a great stride forward had undoubtedly been made. Clamond and others built serviceable thermopiles, but they were inefficient and gradually deteriorated. This dismal fact eventually dismissed a horde of workers from the field; they had done what lay in their power and their labors, although commendable, were more the efforts of imitative mechanics than systematic or logical inventors. Thus it seems that the pathway has been trodden only near the gate. In the volume on "Heat," by P. G. Tait, M. A., is an interesting chapter on Thermo-Electricity. The proposition that the electromotive force due to a heated metal couple will rise to a certain point and then gradually fall, is an evidence that some peculiarity exists about the phenomena that has as yet not been removed. The interpretations of Thomson do not suffice, and in fact, although reduced in many cases to a diagrammatic basis, explanations are lacking at every turn.

This, then, is a comparatively new field—old in the history of electrical applications, but young indeed as regards its development. Some genius to be may now weave a garland that will crown him forever with immortal fame.

New Petroleum Motor.—Apropos of autocars, which are quite the topic of the hour, there is a new type of petroleum motor said to be characterized by great simplicity of mechanism, and which has just been introduced in France. The engine has been examined by a contemporary, and it is found that the principal feature is the independence of light to cause explosion after the machine is once started; thus, one explosion in some unexplained way serves to produce the next. We are not, however, informed how this arrangement is effected, and until we know a little more upon the subject, we are not able to judge of its practical capabilities. It seems that the patentee has been able to dispense with the electric spark or light of any sort in the bringing about of the explosion, and thus the great danger of fire is practically avoided. A mineral essence is employed mixed with air by means of a special pulverizer, and this mixture, finding its way into the cylinder through a trunnion in the same way as steam does in an oscillating steam cylinder, produces the further combustion by the explosion which has just preceded. Thus, it follows that the temperature of the cylinder remains stationary and so low that the cooling apparatus generally required is dispensed with. It is supposed that this system will be available for motors which range from 1 to 4 horse power, but not applicable to anything larger

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"Do not advertise and stop,
But advertise and stay;
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Will look for it to-day."

ELECTRO-MAGNETIC INDUCTION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

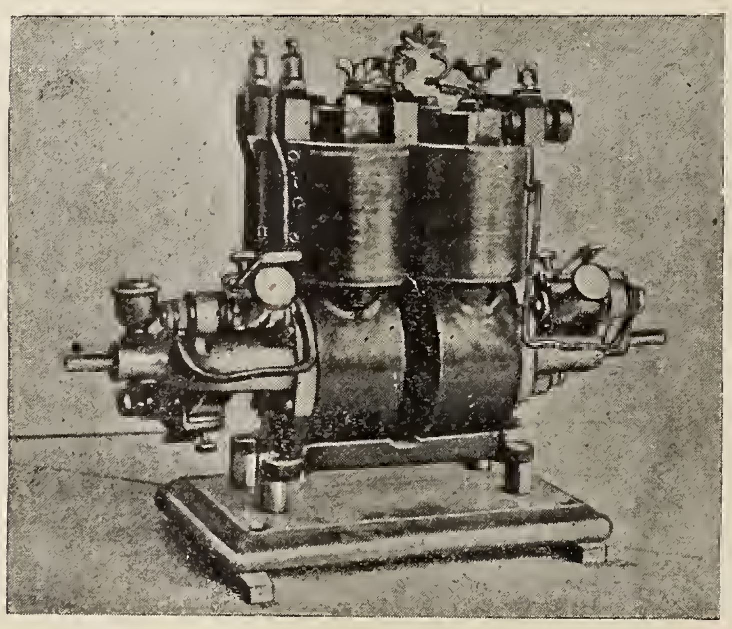
BY NEWTON HARRISON, E. E.

The ordinary lighting current is due to a series of pulsations, so small, however, that they appear to blend into one continuous whole. The arc-light current is a true pulsation, a rise and fall, of the current strength, but a flow which, whether weak or strong, does not change in direction. The remaining current used in commercial lighting is the alternating or sinusoidal current. It derives its name from the peculiar growth, decrease and reversal in direction. It may be observed that entirely different systems of lighting are built upon this difference between each. In the last, transforming devices are required, which have opened up a new field in the transmission and distribution of power.

The entire principle of electromagnetic induction depends upon the mutual reaction occurring between a wire and a field of magnetism. Either, may be moved in the neighborhood of the other and an electro-motive force will be excited.

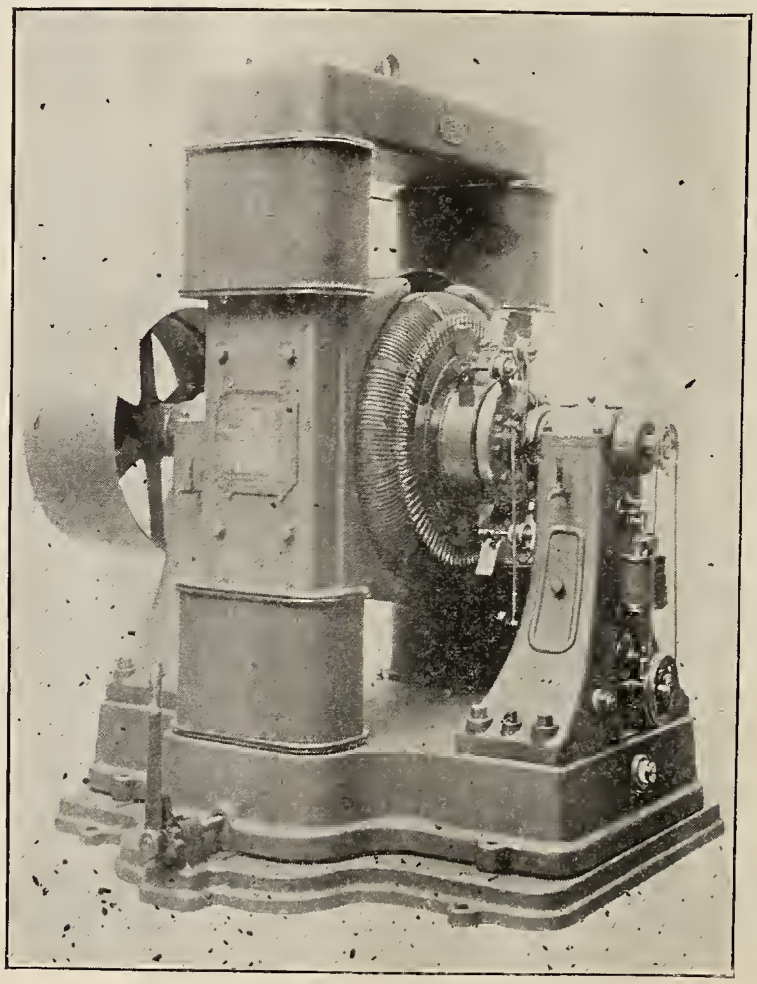
It is important that this fact be received as an absolute truth, which in any case can be depended upon with the same surety that gravitation, or the revolution of the earth, is relied upon.

An invincible principle like this is the mirror with which we reflect all other truths; it is the foundation—the stepping-stone—without which further progress is impossible.



CONTINUOUS CURRENT TRANSFORMER.

It may be understood from the last statement that either a wire moves in a magnetic field, or the field is moved in the neighborhood of the wire. We can also add that both may take place and still produce the effects spoken of. By moving a wire and a magnetic field so that they mutually interact, we are simply transferring the power required for that motion to the wire. The elastic material required for the transferrence of this energy is the magnetic field; the strained ether. In what di-



MACHINE PRODUCING MINUTE PULSATIONS.

rection does the current flow, and how can it be increased or diminished by this means? In other words, what limitations are there which give but a circumscribed value to the effects of all electromagnetic reactions?

The E. M. F. developed in any case depends upon the number of lines of force cut per second. If a coil is carrying a current and thereby generating a magnetic field, another coil in its vicinity will have excited in it a potential difference of 1 volt if it is moved across the streaming lines of force so that its turns and the magnetic lines give a product of 100,000,000 per second.

Supposing the coil to have ten turns and the field proceeding from the other coil to equal 100,000 lines of force. To excite one volt the product of 100,000,000 must be sustained in a second. At present, with but one move of the coil, only 100,000 lines of force are cut. Therefore, the coil must be moved ten times in a second to generate one volt.

In developing this principle, the same basis is taken that all electromagnetic phenomena consist merely of interactions between a magnetic field and a coil.

For commercial purposes it is necessary that we should know the exact value of the E. M. F. developed with a given number of lines of force and turns.

In all dynamos this first conclusion practically determines the size of the machine. By following this lucid principle still further, the great department of alternating current machinery may be investigated. We have to deal in this case with a series of special devices which have, because of their peculiar nature, successfully resisted all attempts to usurp them. Were it not for the ease of transformation, the life of alternating-current systems would be very short.

But in this fact lies its strength; it is simple and convenient and in certain cases, most economical. The transformer of an alternating-current system consists of a complete magnetic circuit and two coils. A ring of laminated Swedish iron with a coil on each side comprises the total apparatus.

The iron is called the frame of the transformer and the two coils, the

Primary, and

Secondary.

The Primary.—This coil is usually of finer wire than the other. It is the one which receives the current direct from the dynamo and turns it into magnetic energy. It must be carefully insulated from the iron frame and the other coil. In daily practice the primary receives anywhere from 1,000 to 2,000 volts; its function is to magnetize and demagnetize the iron of the frame. For this purpose the coil is specially designed, because it generates a lot of heat when these rapid reversals occur. The primary is made with the proper radiating surface to admit of the rapid emission of heat. It is wrapped around in several layers of insulating tape and in some cases dipped in oil and kept there. The resistance in ohms of the primary is not the only factor which prevents the current from the dynamo injuring it. There is a back electromotive force, called self-induction, which holds the dynamo-pressure in restraint. Its full effect is only felt when the secondary is supplying its full number of lamps with current. As an automatic valve, it is unequalled in its unfailing action at all times and under all circumstances. Were it not for the presence of this invisible regulator, the use of transformers could only be carried on with great difficulty. When the current flows into the primary the magnetized coil at once affects the secondary and causes it to generate an E. M. F.

The Secondary.—The principle elucidated now comes into direct application. The coil has been magnetized for an instant. Another coil wrapped around the iron in a similar manner to the primary is thus subjected to the influence of those lines of force the primary has just generated. If 100,000,000 of these lines of magnetic force sweep through the coil but once in a second, and the secondary consists of only one turn, the pressure developed in it will equal one volt. The design of a transformer hangs upon this fact

ROENTGEN RAYS.

Unaffected by Gravitation.

We are now assured that there is something in the universe which has no gravitative property at all, namely the ether. It was first imagined in order to account for the phenomena of light, which was observed to take about eight minutes to come from the sun to the earth. Then Young applied the wave theory to the explanation of polarization and other phenomena; and in 1851, Foucault proved experimentally that the velocity of light was less in water than in air, as it should be if the wave theory be true.

A Universal Medium.

It was Faraday who put a stop to the invention of ethers, by suggesting that the so-called luminiferous ether might be the one conceived in all the different phenomena, and who pointed out that the arrangement of iron filings about a magnet was indicative of the direction of the stresses in the ether. This suggestion did not meet the approval of the mathematical physicists of his day, for it necessitated the abandonment of the conceptions they had worked with, as well as the terminology which had been employed, and made it needful to reconstruct all their work to make it intelligible.

Function of the Ether.

We now have experimental proof as well as theoretical reason for believing that the ether, once called luminiferous, is concerned in all electric and magnetic phenomena, and that waves set up in it by electro-magnetic actions are capable of being reflected, refracted, polarized and twisted, the same as ordinary light waves can be, and that the same laws are applicable to both.

Albany, N. Y.—Sealed proposals for furnishing the necessary materials and performing the labor for erecting and installing the electric wiring and the fixtures for the north wing, dining-room extension for disturbed patients at the south wing, and the dining-room addition to ward eleven of the main building of the Hudson River State Hospital, near Poughkeepsie, N. Y., may be sent by mail or delivered in person up to twelve o'clock noon, August 6, 1896, to Hon. Amasa J. Parker, President of the Board of Managers, at the Hudson River State Hospital, Poughkeepsie, N. Y., at which time and place the Board of Managers will receive and open all proposals.

New York City.—Plans have been filed by the Hobart Estate, of San Francisco, Cal., for the erection of a fifteen-story brick and steel hotel, at Nos. 1372–1382 Broadway, and 121 W. 37th street, and 114 W. 38th street. Cost, $2.000,000.

New York City.—The North River Electric and Power Co. will erect a one-story brick power house at the foot of 140th street, to cost about $22.000.

Cumberland, Md.—The city government is considering the matter of putting in an electric light plant at its own expense.

Amherstburg, Ont., Can.—Architect A. B. Wood has prepared plans for the erection of a hotel, for L'Hotel Oriental of this place, at a cost of $10.000. Two steel boilers, engines, 250 H.P., 2,000-light dynamo, etc., will be installed.

New York City.—The Y. M. C. A. is going to erect two more new brick club houses. One of the buildings is to be erected at 158 to 162 East 87th street Architect, James E. Ware, 487 Fifth avenue. William E. Knowles, 111 Fifth avenue, has drawn plans for the other building, to be erected at 72 and 74 West 124th street. The structure will be three stories high and cost $70,000.

Greenbush P. O., Albany, N. Y.—An electric railroad is to be built from Greenbush to Nassau.

Exeter, N. H.—The Exeter Boot and Shoe Co. is arranging to light its factory with electricity.

NEW YORK AS A SUMMER RESORT.

A little book with this title, bearing the imprint of the American Bank Note Co., has just been issued by the Passenger Department of the New York Central as No. 19 of its popular "Four-Track Series." Perusal of its pages will reveal the fact that New York is not only one of the world's greatest cities, but that it is in all essentials the greatest summer resort in the world. No other resort has such amusement palaces, such hotels, such facilities for boating, bathing and fishing, such a variety of features for the entertainment and care of summer visitors.

The beautiful little book contains sights and scenes that will gladden the heart of any New Yorker. To strangers, as a souvenir of their visit, it will revive recollections otherwise forever gone. The elegant little photographic reproductions are unexcelled in their pure realism. We live in a mighty city; these sketches will soon prove it to you.

The New York Central is doing the public a real service in calling attention to attractions to be seen nowhere else on this continent.

A copy of "New York as a Summer Resort" will be sent free, post-paid, to any address, on receipt of two 2-cent stamps by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

THE Interior Conduit and Insulation Company had the most unique and attractive exhibit at the recent Electrical Exposition. The eye of the visitor was immediately attracted by the large electric sign spelling out the name of the company. An interesting technical exhibit was the combination of a 2-h.p. Lundell motor directly connected to a pony two-revolution printing-press, running at about 175 revolutions per minute. Exhaust fans and Sturtevant blowers were in operation, driven by Lundell motors directly connected.

A Mason & Hamlin two-manual organ, to which was attached the standard Lundell Organ Blowing outfit, was operated in the evenings by an organist.

The combination little electric light plant, consisting of a Case engine, directly connected to a 10 h.p. Lundell generator, on one bed plate, had the appearance of being both compact and of commercial utility.

The Company exhibited to the public for the first time their complete line of new underground conduits for the reception of trolley feeders, telephone and telegraph cables and electric light wires. Samples were also given to visitors of the new steel-armored interior conduit.

A very good idea of the exhibit can be gained from the accompanying illustration.

Mr. H. C. Mercer made a report on his recent exploration of certain caves in Tennessee which he had been able to prosecute under the patronage of the University of Pennsylvania, mainly through the liberality of Dr. William Pepper. In Zirkel's cave, on Dumping Creek, Jefferson County, Tenn., crusts of breccia projected from the walls and hung from the roof. From this material the teeth of the tapir, peccary, etc., projected, while in the cave earth below were found bones, nuts, two pieces of Indian pottery and fragments of mica, probably indicating Indian cave burial. There were, therefore, two ages indicated: One ancient, by the breccia, and the other by the cave earth, comparatively recent. All the fossil remains belonged to the breccia and there was no association between them and the indications of human life.—Science.

Interesting Facts in Science.

Mica Mines.—An interesting geological fact is that the wild and apparently worthless mountain region around Bakersville, N. C., is the main source of mica supply for the United States. Mica mining is one of the greatest industries in North Carolina, and has yielded fortunes to those engaged in it. Mica is found in all sorts of blocks of various thicknesses and shapes, and can be split and resplit almost ad infinitum, or until it becomes the thin, transparent, flexible wafer of commerce; the material is by nature embedded in or scattered through the feldspar in masses large or small, close together or far apart, and is blasted from the rocks by means of dynamite, the purer veins being found between walls of slate. From the mines it is taken to the shops, where it is split into thin sheets, trimmed into regular forms, and made ready for the market, the price varying with the size and color of the sheets. The average size is about 4 by 6, though rare sheets of 24 by 18 inches are sometimes found.—Tradesman.

TELEPHONE VS. TROLLEY.

Tuesday, in Montreal, Judge Davidson rendered judgment dismissing the action of the Bell Telephone Company against the Montreal Street Railway Co. The case is an interesting one. The suit of the telephone company was for $30,000 damages. The introduction of the electric trolley car system into Montreal in 1892, the plaintiff claimed, caused and has been causing ever since, serious disarrangement of the telephone service, necessitating the adoption of a number of expensive contrivances to counteract the effect of the presence of the trolley wires. We have not the judge's reasons for his ruling, but his action on general principles seems sound. When the telephone company erected their poles and stretched their wires along the streets of Montreal they undoubtedly did so subject to whatever improvements the city might see fit to make of its own motion, or might allow other parties to introduce. No monopoly of the streets was granted the telephone company. When, therefore, the time for electric propulsion of street cars arrived it was adopted, and the Montreal public were given the benefit of the invention. There seems no reason in equity why the telephone company should not be made to adjust itself to the new conditions without levying upon the street railroad company and through them on the public.—Salem (Mass.) "Mercury-Gazette."

A VOLATILE SOLVENT FOR COTTON.

It is stated that a London chemist has discovered a volatile solvent for cotton—that is to say, the liquid, whatever it is, dissolves cotton, then it evaporates and leaves pure cotton behind in an amorphous pulp. The pulp may be rolled just as paper pulp is rolled into a homogeneous fabric of any thickness required. All the attempts to dissolve cotton hitherto have been unsuccessful. The nearest that has been attained is the conversion of the fibre into the amorphous condition known as cellulose, from which nitroglycerine and zylonite are made. These modifications of cellulose are highly dangerous, being subject to spontaneous combustion. The new solvent, however, does not change the chemical nature of the cotton fibre—it is cotton though not fibrous, after deposition from solution.—The Indian Textile Journal.

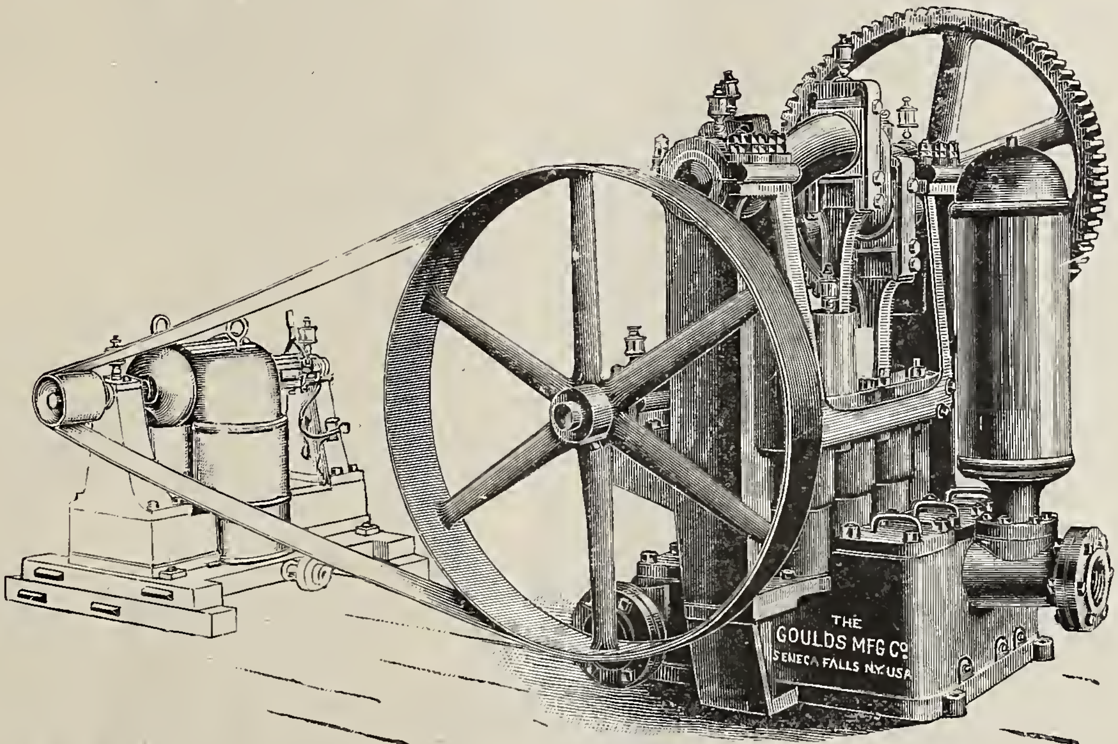
The Niagara Falls are reckoned to do as much work as 266,000,000 tons of coal could do in a year, taking the consumption of fuel at four pounds per horse-power per hour. That is to say, almost exactly as much as all the known coal in the world could do in one year.—Indian Textile Journal.

GOULD'S PUMPS.

The Goulds Manufacturing Co. have a plant for the manufacture of pumps which meets in every respect the requirements of the trade. Their Triplex Electric Power Pump is designed to carry a pulley and is driven by a motor. No special foundation is required and the pump and motor may be placed upon any support ten or twelve feet apart. The pump has a large valve area, which allows of smooth running at high speed. Each connecting rod has bronze-bushed bearing in plunger and strap head at crank, with phosphor-bronze box, and adjustment for wear. The gear is machine-cut and pinion rawhide with bronze shroud. The working parts may be made of bronze, if so required. This pump can be used for elevations to 300 feet, or equivalent pressure. The sketch illustrates the method of pumping and the installation of a complete outfit for this purpose. The portability, compactness and convenience of the Goulds Manufacturing Co.'s Triplex Electric Mine Pumps cannot be excelled.

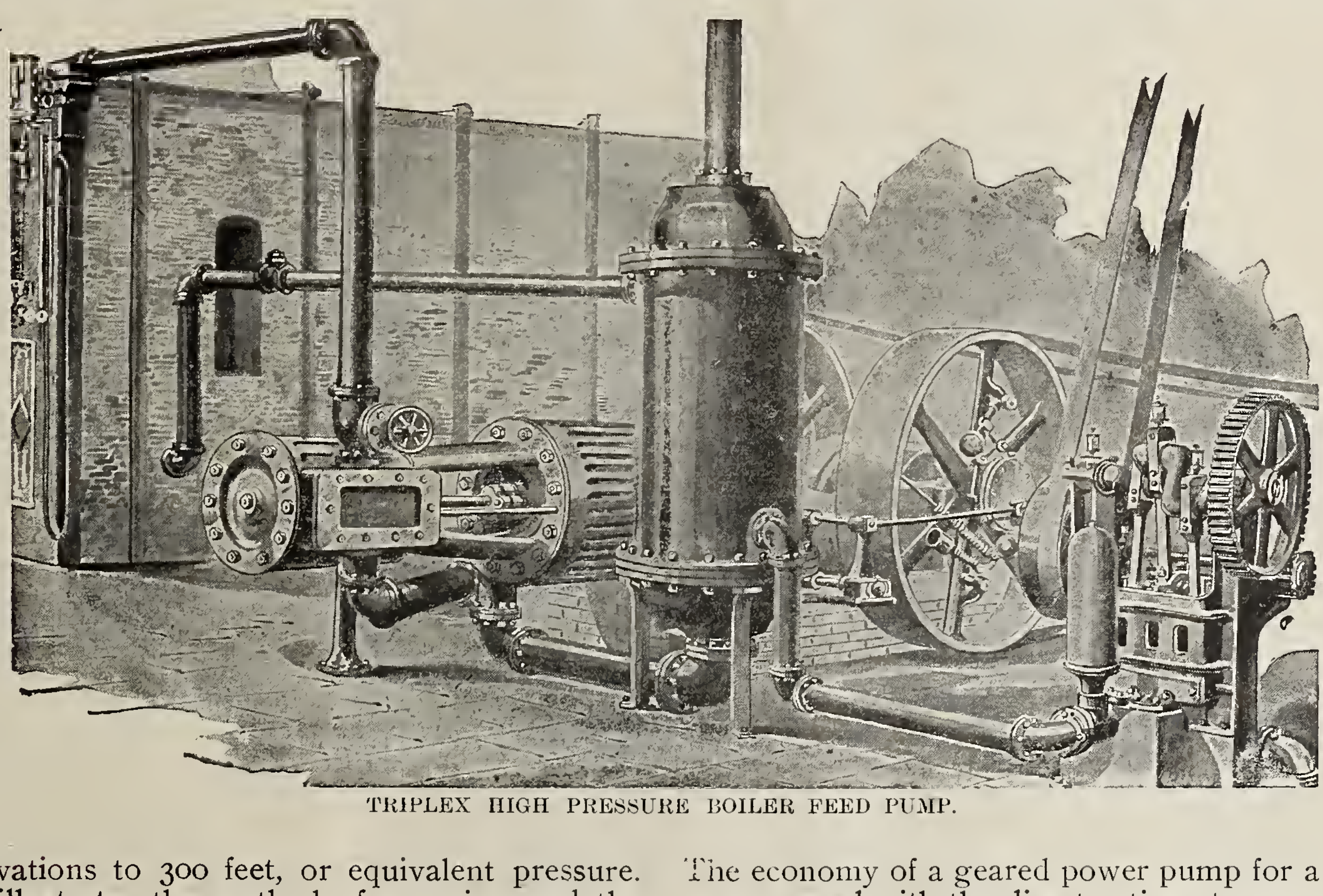
Their plan of using such happy combinations shows their shrewdness and long-headed business tact. They say: "At this point we would suggest to the mining engineer the economy of high pressure steam multiple expansion engines; the efficiency of electric generators at 95 per cent. or better; the efficiency of electric motors at 90 per cent. or better, and the ease and safety with which electric conductors can be placed in a mine."

The horizontal triplex pump they sell is mounted on a truck, to facilitate moving it about in the mine. The plungers are phosphor-bronze and outside packed. The cylinders and glands are bronze-lined. The gearing is machine-cut and runs quietly. The motor pinion is of bronze. Adjustments for taking up the wear are provided. The truck complete is included with the pump, but not the motor.

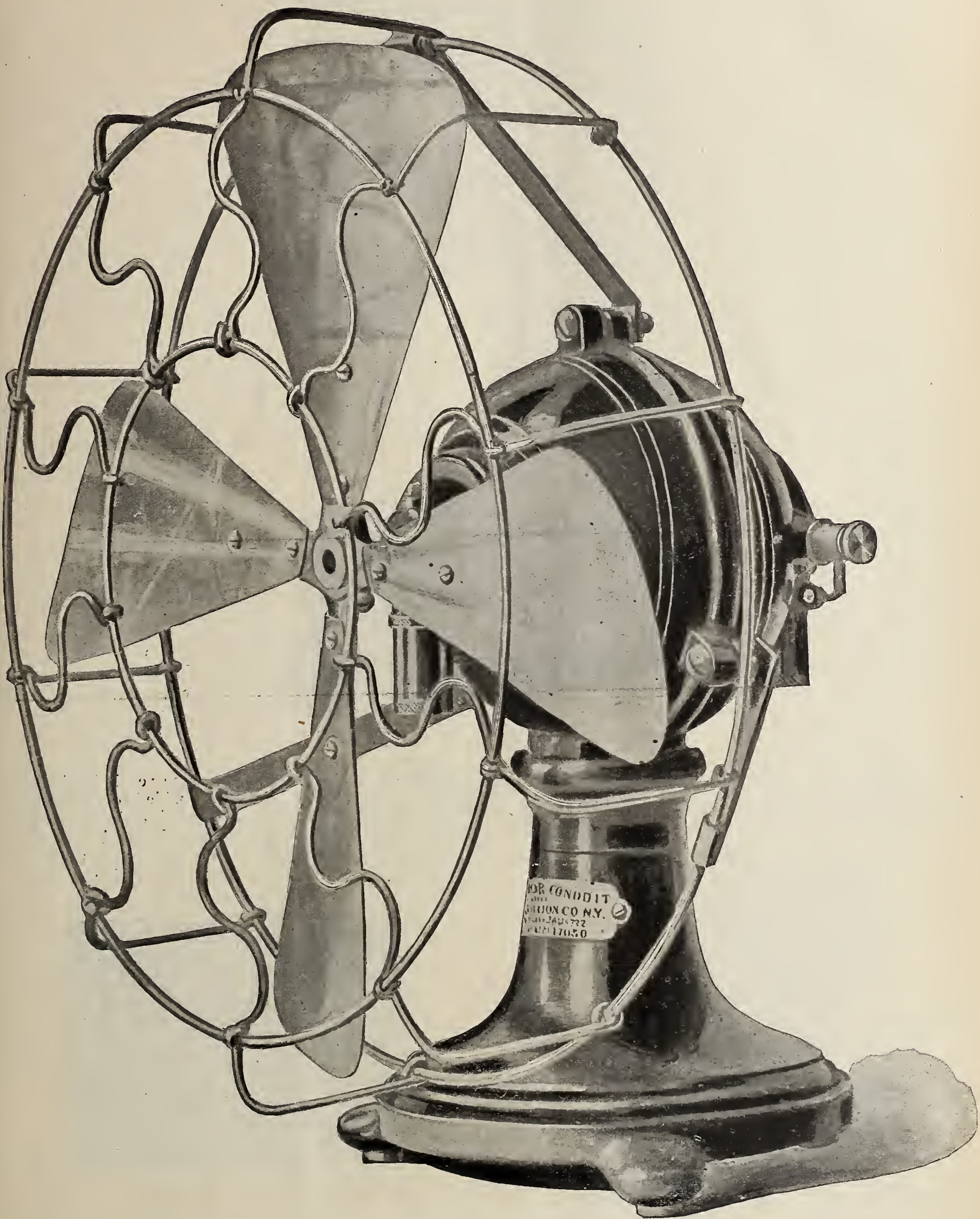


TRIPLEX ELECTRIC POWER PUMP.

The Gould's triplex power boiler feed pump is used in steam plants where compound engines are used, with boilers carrying steam at 100 to 150 pounds pressure. The economy of a geared power pump for a boiler feeder as compared with the direct acting steam pump has been long recognized by intelligent engineers. In all respects this company can claim just credit for the superiority of their work and the rapidity with which they supply pumps for all kinds of work.


TRIPLEX HIGH PRESSURE BOILER FEED PUMP.

The Goulds Manufacturing Co. have their large factory and main office at Seneca Falls, N. Y., and their warerooms at No. 16 Murray street, New York.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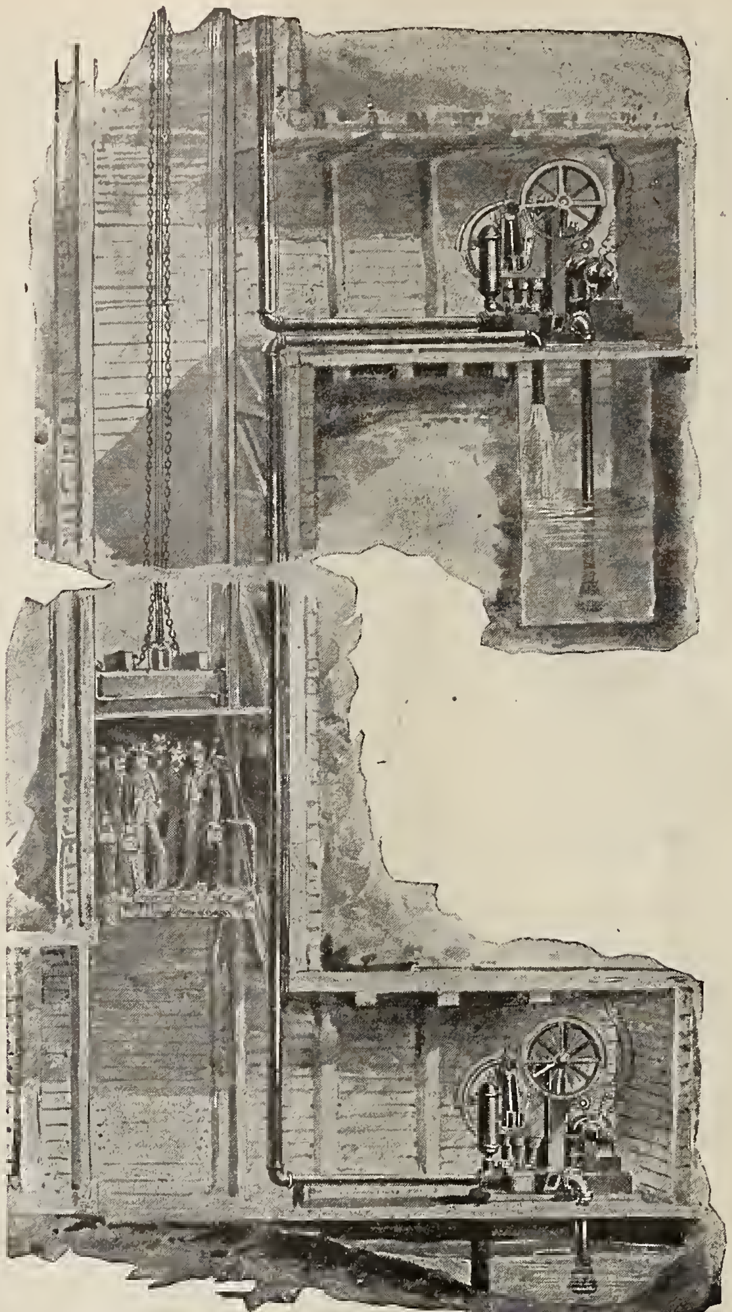
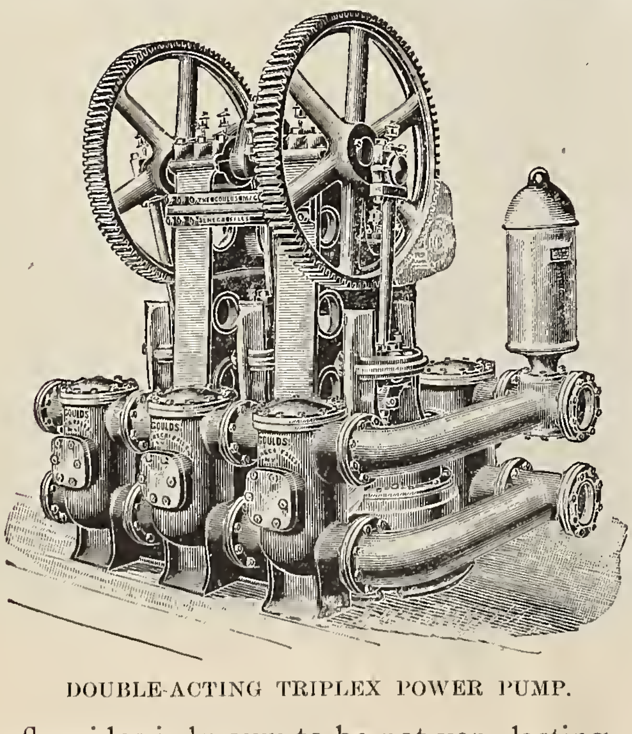
A large variety of pumps are shown in the sketches, which serve every imaginable purpose in mining and steam engineering.



TRIPLEX ELECTRIC MINE PUMP IN OPERATION.

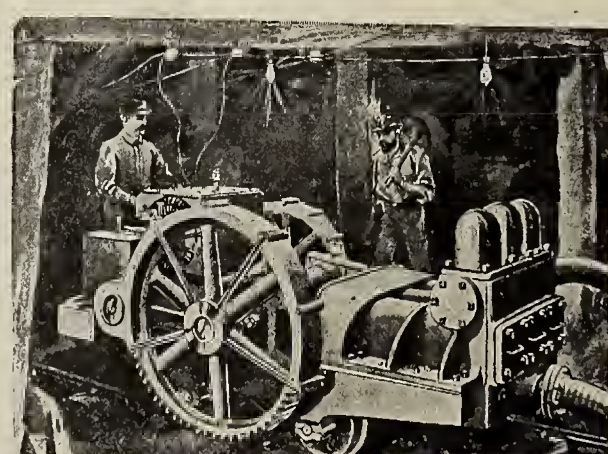
EASILY FUSIBLE OPAQUE GLASS

The opaqueness obtained in fusible glass used for enameling, glazing, etc., by the addition of alkali fluorides



DOUBLE-ACTING TRIPLEX POWER PUMP.

or silica fluorides is known to be not very lasting. But if there are added to such a batch combinations of tin or cerium, for instance, fluoride of tin or cerium, an unalterable opaque coloring is obtained that is more solid than could be produced by any one of the compositions used, under the same conditions. This addition can amount to 10 per cent. of the batch. The same result is obtained when the combinations named are added to glass which already has been melted together with alkali or silica fluorides; of course, the whole mass has to be remelted in this case. Fluoride or silico-fluoride of tin, fluoride or silico-fluoride of cerium and fluoride of boron



TRIPLEX ELECTRIC MINE PUMP.

used each for itself will produce equally unalterable opaque glass. — Moniteur de la Ceramique et de la Verrerie.

Montreal, Canada.—The Lachine Rapids are to be used to generate electricity for lighting Montreal.

POSSIBLE CONTRACTS.

Mason City, Ia.—A 25-year franchise has been granted for an electric street car system at Mason City. A line will also be built from that city to Clear Lake, a distance of ten miles. Work will be commenced within sixty days. Capitalists: L. B. Bradley, of Des Moines, W. E. Brice and L. A. Ong, of Tama. It is proposed by them to build 17½ miles of trolley street car line, and to put in a first-class plant of the latest improvements.

Washington, D. C.—Sealed proposals will be received August 11 for a hydraulic or electric passenger elevator for the United States Custom House and Post-Office building in Newark, N. J., in accordance with the drawings and specifications, copies of which may be had at this office or the office of the custodian, Newark. Wm. Martin Aiken, supervising architect.

Trenton, N. J.—Another new trolley road to connect Trenton and Philadelphia has been projected, and its speedy construction, according to the backers of the enterprise, is positively assured. It is to run from Fox Chase, the terminus of one of the Union Traction Co.'s branch lines, across the country for a distance of about 22 miles to the New Jersey capital.

Rockville Centre, L. I., N. Y. —The lighting question is again being agitated by the people of Rockville Centre.

Bangor, Me.—The special committee appointed by the city council for the examination of the street lighting system and its improvement has arranged for the purchase of a new plant.

New York City.—There is a plan on foot among the members of the New York Turn Verein, who occupy the large building at 66 East 4th street, to move uptown. The trustees are making estimates with a view of erecting a $100,000 building on their plot at 85th street and Lexington Avenue.

Brooklyn, N. Y.—Percy G. William and Thomas Adams, Jr., owners of Bergen Beach, are in negotiation with a Philadelphia capitalist for the sale of about six acres of land with a large water front. The scheme involves the erection of a mammoth hotel and floating theatre. Estimated cost, $1,000,000.

New York City.—A four-story brick municipal school is to be erected by the City of New York on Union avenue, west of 149th street, at a cost of $100,000.

New York City.—Cyrus L. W. Eidlitz has completed plans for the erection of the building for the Western Electric Company, to be erected on the southeast corner of Bethune and West streets. It will be of brick, stone and terra cotta, ten stories in height and fireproof. The estimated cost of the structure will be about $1,000,000.

Piedmont, W. Va.—Prices and information are being secured by the street committee in regard to an electric light plant, which the council think of installing in connection with the pumping station.

Port Richmond, S. I., N. Y.—The Midland Electric railroad is about to lay a double track on Jewett avenue and Richmond terrace, Port Richmond.

Morristown, N. J.—Work on the proposed trolley road at Mt. Arlington, Lake Hopatcong, has been postponed until September 18, when it will be hurriedly pushed to completion.

NEW CORPORATIONS.

Lyons, N. Y.—A corporation captitalized at $60,000 to be known as the Wayne County Traction Company, to construct and maintain an electric railroad between Lyons and Newark, has been formed. President, A. C. Robertson, Athens, Pa. Vice President, Orlando F. Thomas.

New York City.—The Fischer Electric Clock Co., to manufacture electric clocks in New York City. Capital, $100,000. Directors, James C. White, Frank L. Sheldon, 10 Wall St., and Edward Righter, of New York City.

San Francisco, Cal.—The M. Kollman Company, dealers in electrical devices, has been incorporated with a capital stock of $100,000.

New York City.—A German cable company has been formed under the name of the Deutsche Seetelegraphengesellschaft, with a capital stock of $800,000, to lay a cable between Germany and Spain, which will probably be continued to the United States later on.

Columbus, O.—The Century Power and Lighting Company has been incorporated with a capital stock of $10,000.

Buffalo, N Y.—The F. P. Jones Co. has been organized to manufacture electrical apparatus, with a capital of $21,000. Directors: F. P. Jones and others.

Jefferson City, Mo.—The Montezuma Electric Co., of St. Louis, has been incorporated with a capital stock of $2,400, by A. Beck, O. Shamsen, Henrietta Plate, and others, to do a general electric business.

English, Ind.—An electric light company was organized. Joseph H. Finch is president; Wm. L. Gregory, vice-president and secretary. Capital, $5,000.

NEW TELEPHONE COMPANIES.

St. Paul, Minn. Articles of incorporation have been filed with the Secretary of State by the American Telephone and Telegraph Co. of Minnesota. Capital stock placed at $10.000. Limit of liabilities, $100,000. The incorporators are Edward J. Hall, E. P. Meany, Melville Eggleston, J. C. Vailand, A. E. Holcombe. To construct, maintain and operate telephone and telegraph lines in the State of Minnesota.

Old Monroe, Md.—A stock company is being organized by E. R. Williamson and others, for the building of a telephone line between St. Charles and Old Monroe, and intermediate points.

St. Louis, Mo.—The Grant City Telephone Co., of Grant City, has been incorporated by A. A. Keko, J. E. Schoter, J. J. Baker, and others. Capital stock, $1.000.

Houston, Tex.—The Bosque County Telephone Company filed its charter today, with a capital stock of $1,000. The purpose is to build a line from Morgan to Meridian, in the same county, and other points.

TELEPHONE NOTES.

Jacksonville, Fla.—The entire Orlando telephone system was sold last Monday, under foreclosure, to the Phœnix Telephone Company, of New York. This is the company that furnished the 'phones, wires, etc. It is generally undrstood that they will not operate it themselves, but that they will sell to some other party.

Carrollton, Ill.—An ordinance has been passed granting a franchise to the Citizens' Telephone Company, which is to connect neighboring cities with Carrollton.

Manchester, N. H.—The telephone system is to be extended from Epsom to Northwood Narrows.

Effingham is to have telephone connection.

Cottage Grove, Ore.—A telephone line is being constructed from Willamina, through Sheridan and Ballston, to McMinnville, where it will connect with the long distance line.

Milwaukee, Wis.—The Northwestern Electric Telephone Company has been granted a franchise to put in a system at Racine.

TELEPHONE PATENTS.

ISSUED JUNE 30, 1896.

562,807. Telephone Attachment. Will W. Dale, Fostoria, Ohio, assignor of two-thirds to Levi Harbaugh and S. L. Ghaster, same place. Filed July 10, 1895.

562,906. Signaling Apparatus for Telephone Lines. Frank R. McBerty, Downer's Grove, Ill., assignor to the Western Electric Company, Chicago, Ill. Filed October 29, 1895.

563,073. Apparatus for Telephone-Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 12, 1895.

563,084. Telephone System. James G. Smith, New York, N. Y., assignor of one-half to Robert G. Vassar, same place. Filed August 6, 1894.

563,245. Telephone-Switchboard System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed November 4, 1895.

Ralph S. Townsend, No. 1300 Broadway, architect, has prepared plans for a brick office building to be erected at Nos. 12-16 John street, for the Anderson estate, Jerome avenue, near 165th street, at a cost of $175,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued June 30, 1896.

562,796. Electric Railway. Henry Brandenburg, Chicago, Ill., assignor to Charles Austin Bates. Filed March 11, 1895.

562,806. Conduit for Electrical Conductors. James F. Cummings, Detroit, Mich., assignor of two-thirds to Charles H. Freeman and William C. Yawkey, same place. Filed March 4, 1895.

562,808. Means for Protecting Underground Electrical Conductors. Frederick Davis and Rookes E. B. Crompton, London, England. Filed April 11, 1893. Patented in England February 1, 1892, No. 1,878, and in Belgium May 6, 1893, No. 104,590.

562,850. Electric Gas-Lighting Apparatus. Frank O. Plummer, Worcester, Mass, assignor to himself and Edwin W. Ham, same place. Filed August 16, 1895.

562,864. Dynamo-Electric Machine. Norman W. Storer, Wilkinsburg, Pa., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Filed October 2, 1895.

562,868. Dynamo-Electric Machine. Charles C. Warren and Halbert B. Warren, Chicago. Filed January 31, 1896.

562,870. Car-Fender. Octavius A. White, New York, N.Y. Filed January 18, 1894.

562,890. Electric Railway. Bruce Ford, Johnstown, Pa. Filed August 30, 1895.

562,891. Electric Hand-Lighting Gas-Burner. George J. Galbraith, Boston, Mass., assignor to the Electric Gas Lighting Company, same place. Filed April 18, 1896.

562,894. Electric-Railway. William E. Hanshue, Kalamazoo, Mich., assignor of three-fourths to Edgar E. Brownson and Edmund S. Rankin, same place. Filed February 27, 1894.

562,904. Trolley-Wheel. Ignatius B. Metzger, Canton, Ohio. Filed June 20, 1895.

562,917. Thermostat. Charles B. Rogers, Stevenson, Md. Filed April 1, 1896.

562,924. System of Electrical Distribution. Gordon J. Scott, Philadelphia, Pa. Filed January 3, 1896.

562,925. Automatic Speed Controller for Electric Cars. Henry A. Seymour, Washington, D. C. Filed May 19, 1896.

562,929. Electric Signal. Charles H. Sherwood, Utica, N. Y., assignor of one-half to Henry C. Lyman, Sherburne, N. Y. Filed October 21, 1895.

562,937. Electric Hand-Lighting Gas-Burner. Henry C. Thomson, Boston, Mass., assignor to the Electric Gas Lighting Company, same place. Filed April 18, 1896.

562,942. Car-Fender. Harold A. Webster, Haverhill, Mass., assignor to Herbert B. Newton, same place. Filed March 30, 1896.

562,972. Trolley. Charles E. Powell, Bryn-Mawr, Pa. Filed September 19, 1895.

562,980. Cut-Out for Electric Circuits. George W. Scovil and Edward F. Gooding, Elgin, Ill. Filed August 27, 1895.

563,016. Electrode for Galvanic Belts. Edmund S. Collicott, London, England. Filed May 18, 1896.

563,025. Electric Signaling Apparatus. Mortimer Du Perow, Washington, D. C. Filed August 3, 1895.

563,032. Electric Heater. Willliam S. Hadaway, Jr., New York, N. Y. Filed February 27, 1896.

563,033. Automatic Alarm for Postal Chutes. Timothy F. Hagerty, Woburn, Mass. Filed January 21, 1896.

563,052. Electric Program-Clock. Dora Ogden, Columbus, Ind., assignor of one-half to Girnie L. Reeves, same place. Filed October 12, 1895.

563,062. Car-Fender. Richard B. Pullan, Cincinnati, Ohio. Filed January 9, 1896.

563,094. Electric Railway. James Tatham, Philadelphia, Pa. Filed September 1, 1891.

563,109. Car-Fender. Oscar L. Whitney, Cambridge, Mass. Filed September 21, 1895.

563,127. Galvanic Battery. Edward S. Boynton, Brooklyn, N. Y. Filed February 21, 1895.

563,148. Telegraph Alphabet. Samuel V. Essick, Yonkers, N. Y. Filed September 16, 1895.

563,149. Telegraphy. Samuel V. Essick, Yonkers, N. Y. Filed September 27, 1895.

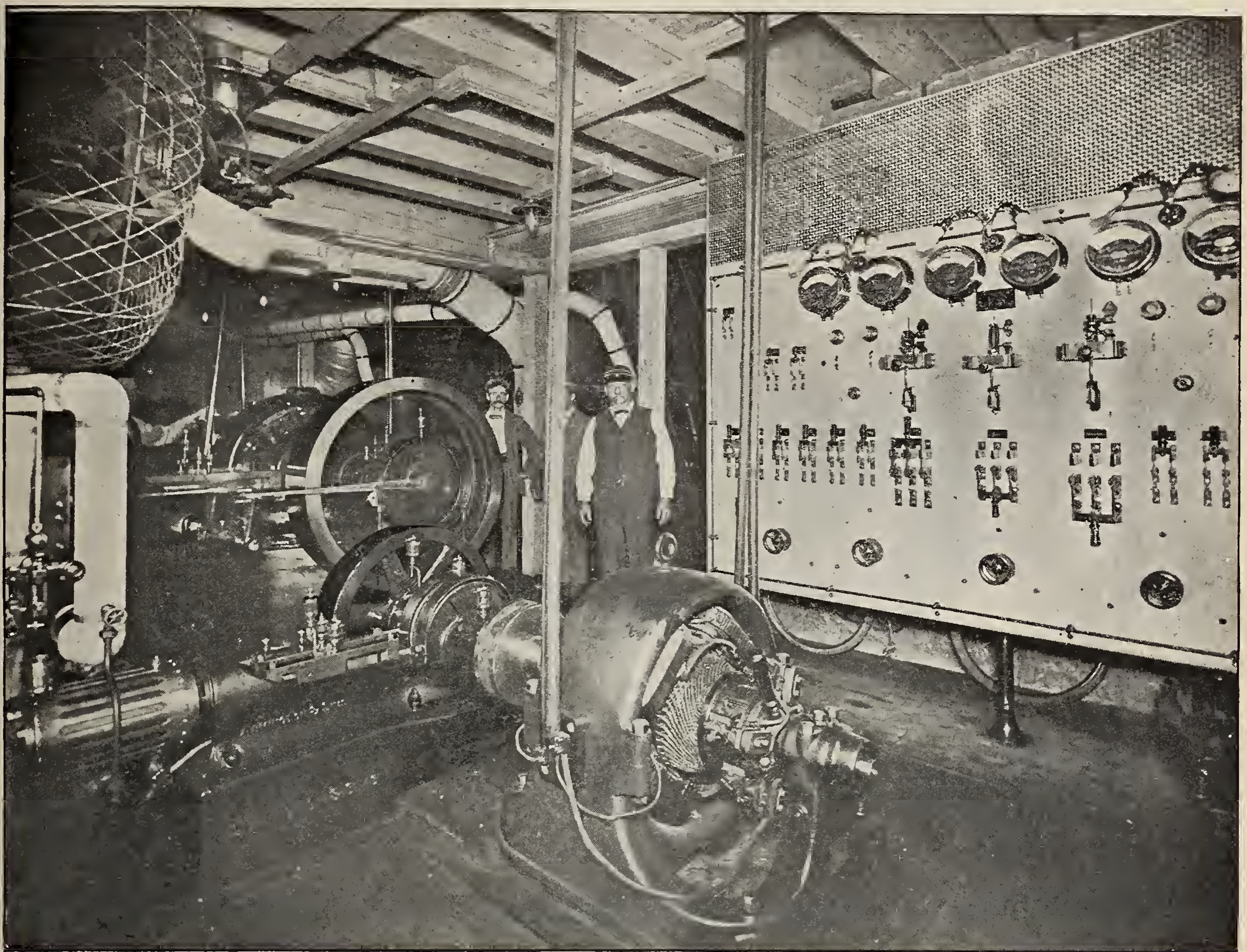
563,203. Fire-Alarm. Josiah R. McCoy, Marshalltown, Iowa. Filed July 10, 1893.

563,232. Hanger for Lamps. Erastus F. Hershaw, Abingdon, Ill. Filed March 13, 1896.

563,244. Electric-Railway Trolley System. Willie C. Keithly, San Francisco. Cal. Filed October 22, 1895.

The Electrical Age.

Vol. XVIII. No. 6 NEW YORK, AUGUST 8, 1896. Whole No. 482



PLANT ON BOARD THE STEAMSHIP ADIRONDACK.

A MODEL STEAMBOAT PLANT.

The People's line, some weeks ago, placed into service a new steamer, the Adirondack, and had it equipped with a first-class electric light plant.

Mr. J. P. Hall, of No. 143 Liberty street, was the electrical contractor, under whose experienced care the wiring was properly installed. The electric light plant, set up under the supervision of Mr. S. E. Drake, is, without doubt, one of the finest ever placed on board a vessel of this kind. It seems that, besides ocean greyhounds, the smaller craft are coming to the conclusion that a closer attention to the comfort of their passengers will insure a greater and more profitable popularity. The People's line are wide-awake on this subject, and in the equipment of the Adirondack have demonstrated their views in a most practical manner.

A marine boiler feeds the engines with a pressure of 40 pounds. Before reaching the engine it passes through a Stratton separator and is thus dried. The engines are Armington and Sims', two in number, sold by E. P. Hampson, No. 36 Cortlandt street, driving, separately, a pair of 800-light Westinghouse generators. The whole runs noiselessly and without perceptible vibration. Mr. Robt. Keasby, of No. 54 Warren street, supplied the magnesia sectional covering used on the steam piping. The engine room is refreshingiy cool. At one corner, a large pressure blower fills the room with pure air; at the other is an equally vigorous fan absorbing it rapidly, and thus creating between the two a strong current. A pair of Worthington pumps are busy supplying water to the boiler and help to complete this scene of engineering completeness. The engines are in communication with a Worthington jet condenser connecting with the exhaust, the water from which passes overboard. The generators each have a pair of Weston station instruments, and a powerful search light is likewiseequipped. The dynamos are self-regulating, connected in parallel, and feed twenty-

five circuits. A smaller generator, in addition to the two larger ones, of 10-kilowatt capacity, is direct-connected, like the rest, to a 15-horse power Armington & Sims. The wiring is brass armored, conduit and circular loom. In many parts lead-covered cable is used All the wire is of uniform grade and comes from the Habishaw factory. Carpenter enamel rheostats add a little to the regulating devices of the dynamos, and another rheostat places the search light under direct control. A Russell See indicator gives immediate notice if either of the electric side lights fail. The elegant switchboard of white marble is provided with switches controlling the main circuits on the saloon deck, gallery, etc. The entire vessel is remarkably well wired. Beautiful chandeliers, ceiling lights and pillar fixtures ornament the interior. It is a pleasure to look upon such work, in which evidently no expense has been spared to make it an unparalleled success.

ALTERNATING CURRENT APPARATUS.

BY C. KAMMEYER.

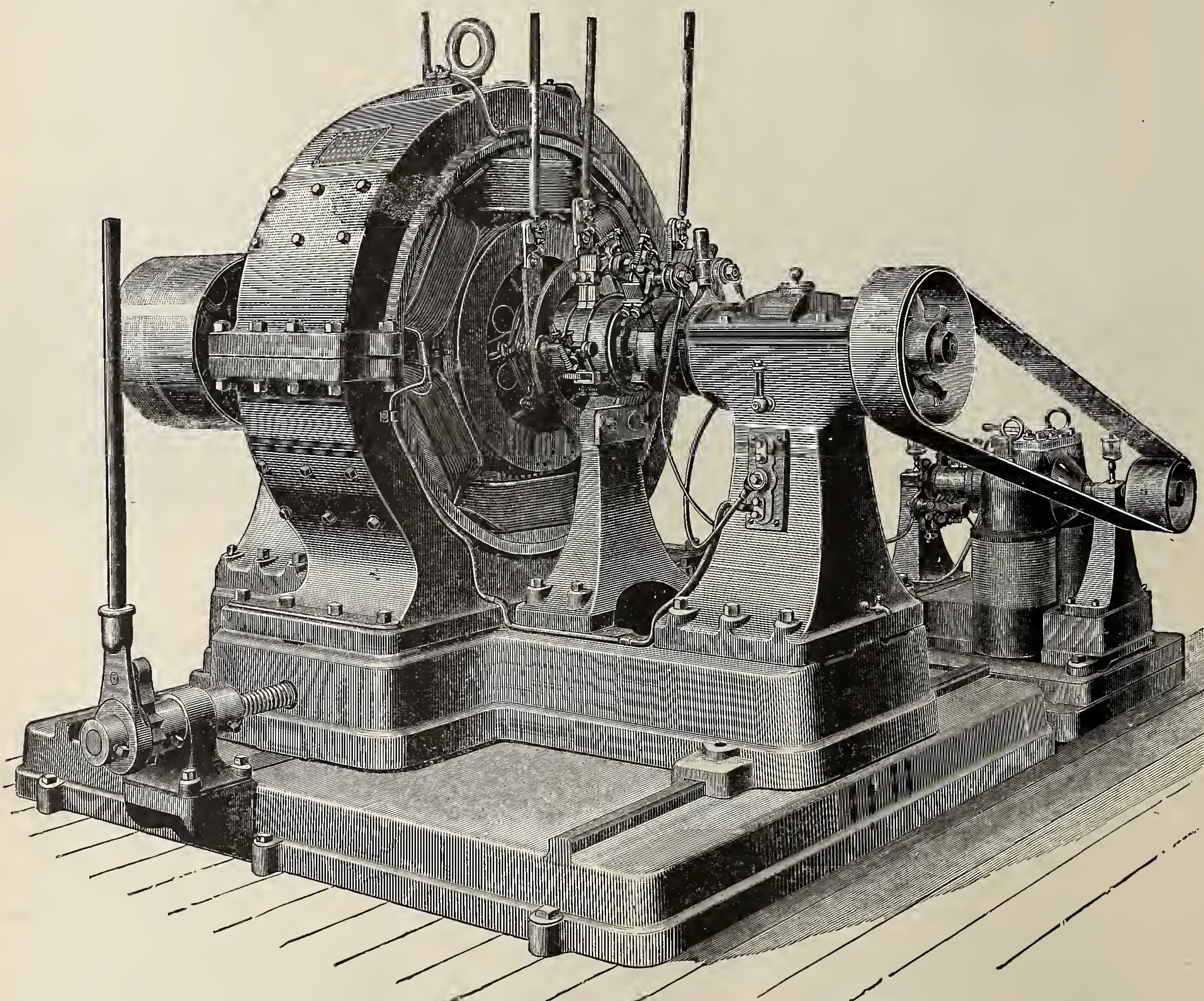
(World's Fair Electrical Engineering.)

Among the various electrical machines now in use for the production of light, heat or power, the alternating current dynamo with its accessories, such as transformers, etc., occupies a prominent position. It goes without saying, that in the operation of alternating current machines, as well as direct current apparatus, the best results can only be obtained where the machinery is handled by men thoroughly familiar with the construction and working of the machinery under their control. Too often, however, the apparatus is shipped and set up by the maker, and started by one of his so-called "experts," who, after a few hasty and generally rather indefinite instructions, takes his departure, leaving the bewildered engineer or dynamo tender to "wrestle" with the "new-fangled" machines as well as he may. As long as everything operates under normal conditions all is well, but very often, should anything unusual occur, the attendant in charge is more or less at sea.

Nearly all, if not all, modern alternators, such as the Westinghouse, Thomson-Houston, National, etc., are built after the same general design, and consist of a multi-polar field magnet of from eight to fourteen or more poles, in which the armature revolves. In one or two systems this arrangement is reversed, i. e., the armature is stationary and the field revolves.

The field magnets are, as a rule, "excited" or magnetized by means of a small direct-current dynamo, called the exciter. This exciter may be a separate machine driven from a countershaft, or from a pulley on the alternator shaft, but is often combined with the alternator by mounting the exciter armature on an extension of the main shaft. Such machines are sometimes, although erroneously, called self-exciting.

In one well-known system the exciter armature coils are wound parallel with and on the same core as the alternator coils, the current being collected by means of a special commutator, but even such an arrangement cannot be properly called self-exciting. Another arrangement consists in connecting the terminals of one of the main armature coils to a special two-part commutator, so



TYPICAL ALTERNATOR.

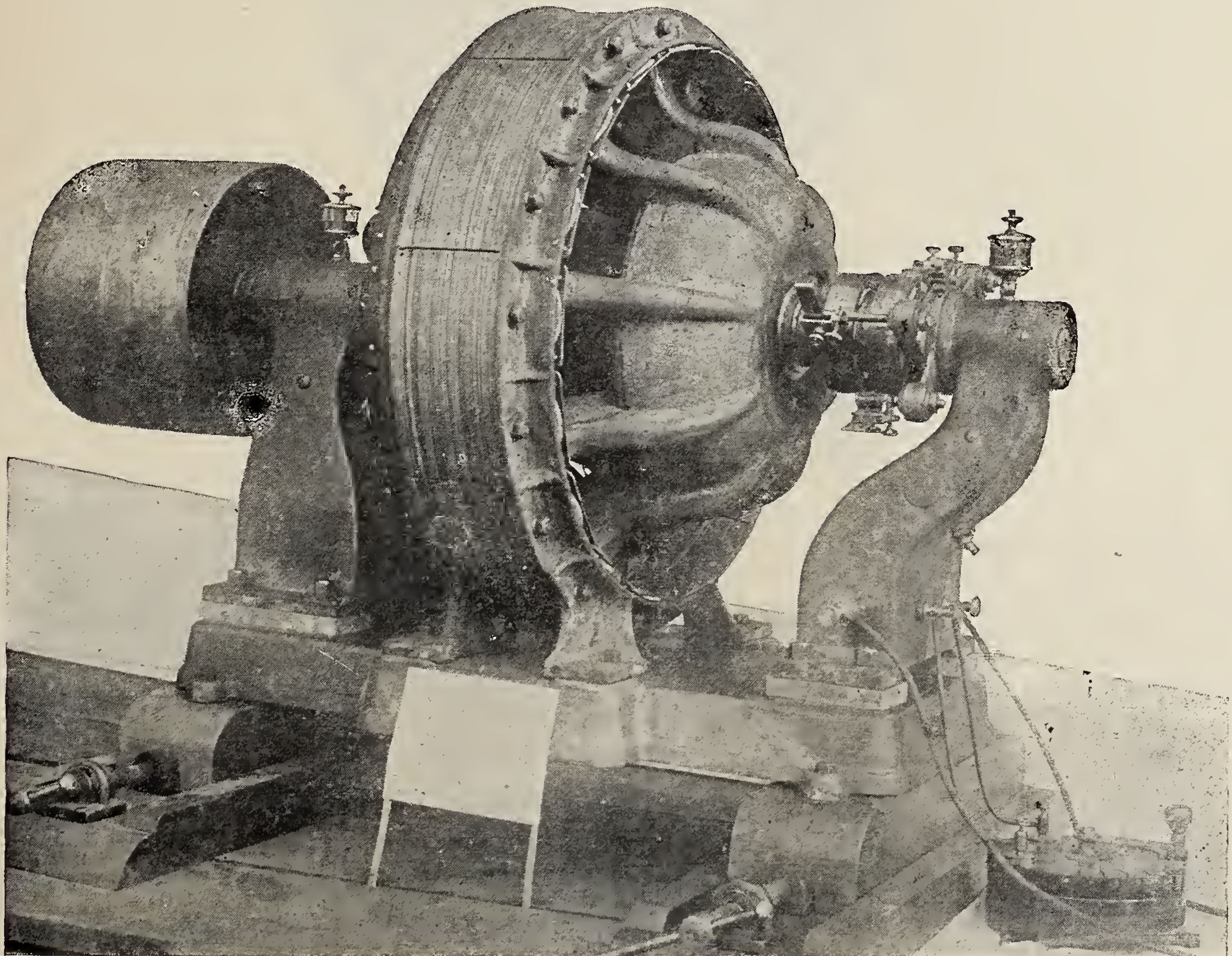
as to transform the alternating impulses into a continuous current, suitable for exciting the fields. The field magnets with their exciter being entirely separate and distinct from the main or alternating current, it follows that any trouble or disturbance of the main circuit can only be due to causes existing on the circuit or armature, and need never be looked for in the field magnet coils or the exciter.

The armature, until recently, was usually of the drum type, with a number of coils corresponding to the number of field magnets wound or laid on the surface of the core, and held in position by means of binding wires of steel or some other suitable material. In some of the latest forms, however, the core is of the Pacinotti type, and has as many teeth or projections as there are field cores. The armature coils are wound on separate forms of paper, abestos or the like, and slipped over the armature teeth, where they are held in position by means of wooden wedges or some other suitable device. This arrangement is quite an improvement over the older type of armature, as it enables us to readily exchange or repair an injured coil without the necessity of removing any bands or binding wires. It also enables us to better insulate the coils, which is of great importance in machines of high voltage.

The armature coils, being wound alternately right and left-handed, are either connected in series or joined in multiple, according to the voltage and carrying capacity desired, the terminals in either case being led to a pair of collector rings. Some makers arrange the armature connections so that they can be readily changed from series to multiple, and vice versa. An armature giving a current of say 1,000 volts and 50 ampères can thus be easily changed so as to deliver a 25-ampère current at a pressure of 2,000 volts.

The armature with its coils revolving past the magnetized field cores produces a current of rapidly changing polarity. The number of alternations depends upon the number of field magnets or armature coils and the speed of the machine. A ten-pole machine, for instance, running at a speed of 1,500 revolutions per minute would give 15,000 alternations, or 250 per second.

The voltage, pressure or electromotive force of an alternator depends upon three things—the speed, number of armature conductors, and intensity of the magnetism of the field cores. Varying either of these factors will therefore produce a corresponding change in the electromotive force or voltage of the dynamo. Given an alternator running at a constant speed, a most convenient way of changing or regulating its voltage consists in varying the exciting current. This can be done by putting resistance either in the exciter or alternator fields, the effect being the same in either case. From this we deduce another fundamental principle—any change in the exciting current will cause a corresponding change in the armature current.



ALTERNATOR WITHOUT EXCITER.

In the operation of dynamos and other electrical machinery, constant vigilance is the price of safety. Do not assume that because a machine ran successfully last night, it will do so again to-day. Before starting, see that the dynamo, exciter and all their parts are scrupulously clean, free from all dirt, grease or accumulation of copper or carbon dust. Carefully examine all binding-posts, connections or screws, and make sure that they are clean and tight. The constant vibration of a machine will sooner or later loosen screws or connectors, and very often an open circuit is the result.

See that the oil cups are filled with a good quality of lubricating oil and adjust them to feed properly. In a new machine supply the oil rather freely at first, until all bearings are running smoothly and cool.

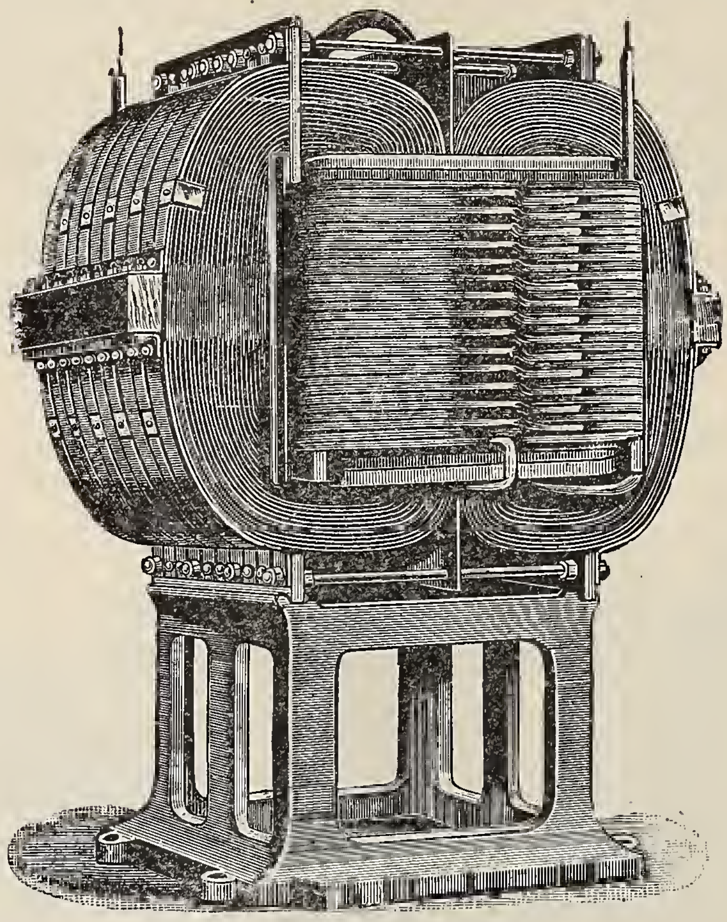
The circuit or circuits should also be examined daily for grounds or escapes. Do not depend upon the behavior of a cheap magneto bell for this, but use a bell that will ring through at least 50,000 ohms; or better

still, procure a suitable resistance set and measure the insulation resistance between line and ground daily. It will be found advisable to keep a record of these daily tests for future reference.

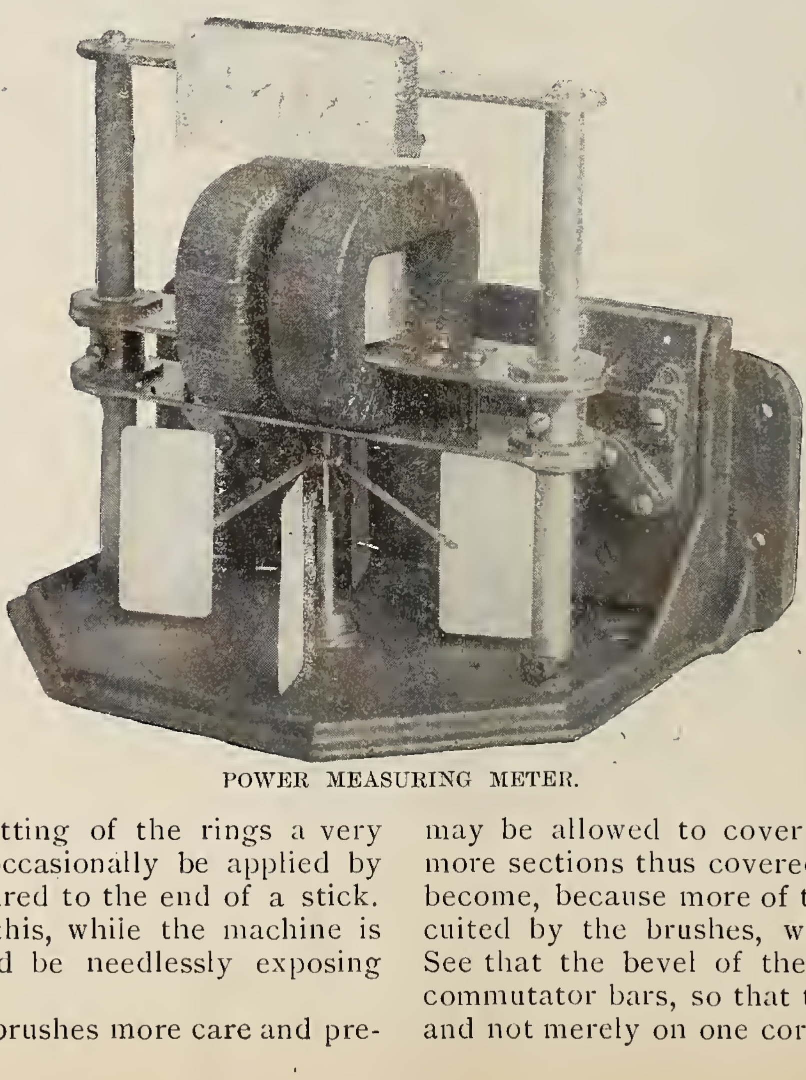
Before starting the machine it will be necessary to properly set the brushes. Specific directions on this point may vary with different systems, but the following general remarks are applicable to all kinds of machines.

The alternator brushes should be set so as to bear on the collector rings with a moderate pressure. The exact position or angle of contact on the rings is immaterial, as the brushes merely serve to collect or take off the current from the rings. To avoid cutting of the rings a very small quantity of oil should occasionally be applied by means of a small linen pad secured to the end of a stick. Do not use your finger for this, while the machine is generating current, as it would be needlessly exposing yourself to danger.

In the setting of the exciter brushes more care and precision are required. Always set the brushes so as to make contact with diametrically opposite segments of the commutator. Most makers mark two opposite sections with a dash or arrow. If they are not so marked, cut a strip of paper or tin and measure around the commutator; one-half of this distance will give the desired points. Before placing brushes on commutator, their ends must be given a proper bevel by filing or grinding. This bevel should be such as to cover not more than one commutator segment when all copper brushes are used. Carbon brushes or brushes having their outer layers or leaves composed of high resistance material (such as the "Wirt" brush) may be allowed to cover more than one section. The more sections thus covered, the hotter the armature will become, because more of the armature coils are short-circuited by the brushes, when passing the natural point. See that the bevel of the brushes runs parallel with the commutator bars, so that the brush bears evenly on same and not merely on one corner or edge. It is of course of



LARGE STATION TRANSFORMER.



POWER MEASURING METER.

the utmost importance that the commutator itself be at all times kept perfectly round, true and smooth. This can only be accomplished by keeping the brushes from sparking at all times and adjusting their tension or pressure so that they will not cut or score the commutator. A very little vaseline should occasionally be applied with the tip of the finger to prevent excessive friction. Should any cutting or scoring take place, the defective spot should be immediately smoothed and polished by holding a pad of fine sandpaper against the commutator, while the latter is in motion. Never under any circumstances use emery on a commutator, as the particles of emery are apt to embed themselves in the soft copper and remain there.

One of the most prolific and annoying troubles met with in alternators is sparking of the exciter brushes. This may be due to several causes. In the first place, the brushes may not be set at the neutral or non-sparking point. This should be remedied by carefully shifting the position of the brushes by means of moving the rocker-arm, until the sparking is reduced to a minimum. If the brushes are set so as to touch exactly opposite points on the commutator, and the latter is round and smooth, no perceptible sparking will occur in a properly designed machine. If, however, the commutator is rough or out of round, or both, it will be impossible to prevent more or less sparking. In this case the commutator must be carefully trued up by means of a file and then polished with fine sandpaper. Wherever it is possible, the trueing up of commutators should be done in a lathe, as it is extremely difficult to get the commutator exactly round by filing it.

If the brushes make poor contact with the commutator, or the latter is covered with dirt or grease, sparking will invariably occur. Where any lubricant is used on the commutator, a very minute quantity will generally be found sufficient, and even this, with any dust or copper dust which may have accumulated, should occasionally be removed by means of a linen rag moistened with benzine, being very careful to not apply this when any current is on, as a spark may ignite the benzine.

Sparking may also be due to the exciter being overloaded, although this is of rare occurrence, and can only be caused by one or more of the alternator fields being short-circuited. This, of course, would prevent the proper working of the alternator itself.

It occasionally happens that an alternator fails to start or generate, when all the connections, etc., are apparently in good working order. The trouble will generally be found in the exciter or its connections. By carefully holding a piece of iron near any one of the alternator fields while the dynamo is running and all connections properly made, we can readily determine whether or not the fields are being magnetized. If no magnetism can be detected, the trouble is in the exciter. See if the exciter fields are being magnetized; if so, the circuit of the alternator fields is open. This nearly always occurs at the terminals of the field coils; if these terminals are connected by means of couplings, these may have become loose from constant vibration, or the ends of the wire may even be broken off short where they leave the coil. Careful examination will generally disclose the faulty place.

(To be continued.)

The Pittsburg "Daily News" says: "The new electric motor at the Westinghouse works, at East Pittsburg, is nearly ready for the final tests. It is expected that Geo. J. Gould, and probably Russell Sage, will be present. If the motor shows the wonderful powers attributed to it by Nikola Tesla, the inventor, there is little doubt that the trial will be wonderfully successful, and its adoption as the motive power for the L roads of New York almost assured. Other motors have been experimented with by the officials of these roads, but none have given the satisfactory results predicted for that of Tesla. It is on the polyphase alternating-current system."

ROENTGEN RAYS.

No Oxygen Salts

Iridium, like the other platinum metals, shows but little tendency to form oxygen salts. The oxides dissolve in acids, but no definite salts are obtained in this way.

The Birthplace of Volta.

Como is the birthplace of Volta, and will celebrate in 1899 the 100th anniversary of his invention of the voltaic battery by an electrical exhibition and congress.—Science.

Tidal Waves in the Pacific.

The Eastern papers quote from the Oregon "Gazette" a description of a tidal wave which has been seen at Victoria and along the North Pacific coast, doubtless caused by the recent Japanese earthquake. On June 15, the residents at the mouth of Rogue River witnessed a series of tidal waves. The fishermen, out in the river with their boats, noticed soon after noon a series of waves coming into the river, increasing the volume of water considerably. The waves continued to grow in size until they became dangerous, and boatmen had to watch carefully to keep from being swamped. Between 2 and 3 o'clock the waves were from three to six feet high. The inrushing volume of water made itself felt for over a mile up the river, beating against the banks in waves several feet high, while the water of the river was backed up for several miles. The disturbance lasted all the afternoon, being at its height from 2 to 3 o'clock, gradually diminishing until the waves disappeared about 6 o'clock. During the afternoon the bar and sea were smooth, with a light swell running. A number of the largest waves in the river were timed, and it was found that they came about a mile apart and traveled the mile in about three minutes. A correspondent of the Washington "Star" writes from Honolulu that the western coast of the island of Hawaii was visited by tidal waves of destructive force from 7 a. m. to 2 p. m. on June 15. At Keanhou the water reached points 35 feet above the sea. The shocks of the earthquake were, it appears, registered by instruments in Italy.—Science.

Temperature of Flames.

Professor Hartley has lately been studying the temperature attained by various flames. The means by which he arrived at the temperatures were test wires of such tenuity that the mass of metal was insufficient to cool the flame, this principle being that which was enunciated by Faraday some years ago. Faraday showed at that time, that a very thin platinum wire could be fused by only a candle flame, and that in such cases the carbon of the flame does not lower the melting point of the platinum. This latter statement has been again demonstrated by Professor Hartley, who has also discovered, by means of spectroscopic observation, that the temperature is as high as the melting point of platinum.—London Electricity.

The Problem of the Sun's Temperature

Has been atacked in a variety of ingenious ways. Rosetti has recorded a temperature up to 10,000° C., using a thermopile; Le Chatelier, 7,600° C., by comparing the absorption of solar rays with that from a hot object; Wilson and Gray, 6,200° C., by balancing, in a Boys' radiomicrometer, the radiation from the sun against that from a glowing strip of platinum; Scheiner, between 4,000° and 10,000°, by measuring the breadth of the magnesium lines in the spectrum. Professor Paschen, the latest observer, considers the wave-length of maximum energy in sunlight as inversely proportionate to the absolute temperature of an incandescent body, and gets 5,130° C.—London Electricity.

STANDARDS OF LIGHT.

(Continued from Page 423.)

By this means the efficiency of the bolometer was nearly doubled. The tinned surface did not tarnish perceptibly during the course of the investigation. It was not smooth enough to reflect a distinct image, and the light reflected from it was to a large extent scattered. The use of a plane-surfaced mirror in such a position would not be allowable, since any slight amount of light in the angle of incidence would cause a different amount of light to be reflected upon the bolometer strip. The use of the irregular-surfaced plate, since it diffuses the light, can scarcely affect the accuracy of the results to an appreciable degree in such work as has been done with this bolometer. Nevertheless, this arrangement is to be recommended only where great sensitiveness is desired rather than the most exact comparison of results.

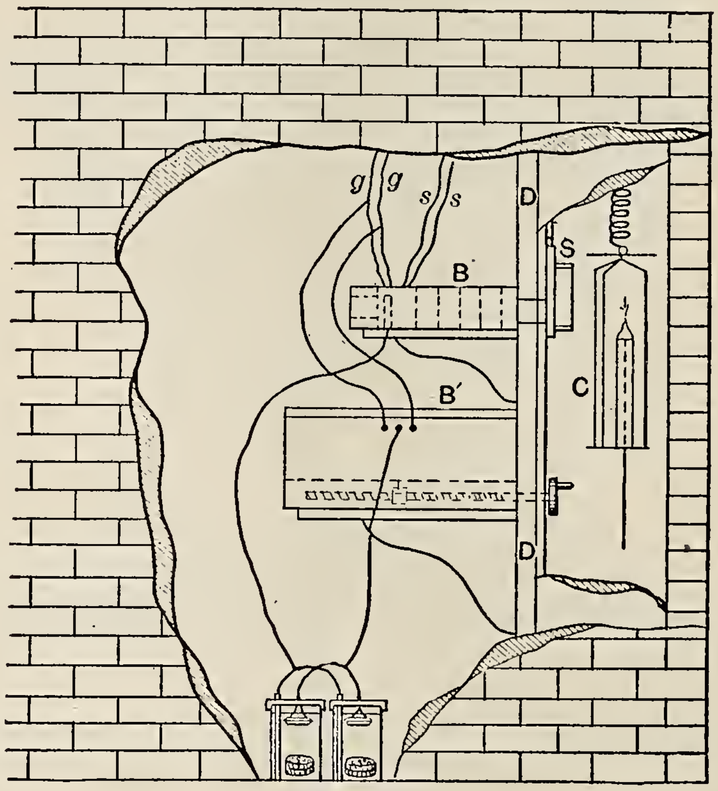


Fig. 2.

The galvanometer employed was of the four-coil type. It was constructed by Prof. W. S. Franklin, after the same general plan as has been followed by Snow,[1] Paschen,[2] and others. When the two front coils were in multiple with each other and the two rear coils similarly connected, and the two pairs were connected in series, the resistance was found to be 190 ohms. The moving parts consisted of four little magnets of piano wire, each about 5 mm. long, and a mirror of thin cover glass, 4 mm. wide by 7 mm. long, all mounted on a slender rod of glass and suspended by a very fine quartz fiber. Any oscillations of the needles were very strongly and effectively damped by the air resistance to the light-moving parts—a very essential condition to the correct operation of the instrument when used to get the variations of a rapidly fluctuating source of radiant energy.

The scale was divided into 100 half-inch divisions, each of which was, in turn, divided into tenths. The distance of the scale from the galvanometer was 100 scale divisions, *i. e.*, 50 inches. With the telescope used, fifths of the smallest divisions could be estimated. In speaking of scale divisions, the half-inch divisions will always be meant.

To test the sensitiveness of the apparatus, the galvanometer was adjusted until the period of the needles was six seconds for a complete vibration. A deflection of one scale division corresponded to a current of 68×10^{-10} amperes.

This deflection of one scale-division corresponded to a temperature rise in the bolometer strips of 0°.00657 C. If we reduce this to millimeter divisions on a scale placed at a distance of one m. from the mirror, we see that one millimeter deflection corresponded to a current of 68×10^{-11} amperes, and the corresponding rise in temperature of the strip was 0°.00066 C.

This temperature sensitiveness is much smaller than has usually been employed in bolometer work, but it was amply sufficient for the purpose. That the bolometer itself was one of high sensitiveness is evident from the fact that this degree of sensitiveness was attained with galvanometer needles swinging in a strengthened field and with a galvanometer of 190 ohms resistance. The conditions for maximum sensitiveness of the bridge would have required a galvanometer resistance of only 0.5 ohm.

The reason for the great sensitiveness lay in the nature of the strips employed. Their area was considerable, the temperature coefficient of the iron was high, and the current through it was large, ranging from 0.15 to 0.20 ampere, the size of the strips permitting the use of a large current without undue heating. As a result of the strong field in which the galvanometer needles swung, the drift due to magnetic changes was usually imperceptible.

The bolometer, compensating resistance, and battery were all placed in an interior room, with thick brick walls, and having communication with the outer room only by a door, D, Fig. 2.

The temperature of this room changed very slowly, and it was quite free from drafts. The bolometer box, B, was placed upon a shelf fastened to the door of the room, and looked out through a hole in the door upon the outer room. A double screen, S, of tin, arranged to slide up and down on the outside of this door, covered up the bolometer strips when desired. The box B′, containing the compensating resistance, was also fastened to the inside of the door. The end of the box through which the screw projected, fitted into a hole in the door, so that the screw would be turned and the bridge balanced from the outer room.

(To be continued.)

Strength of Wire.—A piece of pianoforte wire recently tested at the Watertown Arsenal showed the extraordinary strength of 206 tons per square inch. The wire was one-twelfth of an inch in diameter; larger sizes give a tensile strength of 135 tons and upward per square inch. The metal contained 0.85% of combined carbon.—Industrial World.

Baltimore, Md.—The Bayview Electric Light and Power Co. and the Chesapeake Water Co. have consolidated as the Chesapeake Electric and Water Co. Capital stock, $100,000.

The Electrical Age.

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CONTENTS.

	PAGE
EDITORIALS	
Temperature of the Electric Arc	443
Street Lighting	443
Gas Railways	443
GENERAL SUBJECTS	
A Model Steamboat Plant	437
Alternating-Current Apparatus	438
Standards of Light	442
Alternating Currents	444
Electric Motors in Shop Work	446
EXTRACTS	
Roentgen Rays	441
TRADE NOTES	
Electric Car Motor Patent	447
Portable Electric Propeller	450
The Eck Fan Motor	450
Western Telephone Construction Co	450
Interior Conduit & Insulation Co	447
New Theatre Dimmer	447
Possible Contracts	451
Telephone Notes	451
NEW CORPORATIONS	451
New Telephone Companies	451
PATENTS	452
Telephone Patents	451

TEMPERATURE OF THE ELECTRIC ARC.

To measure an all-consuming heat is a great scientific achievement. Of all great sources of heat perhaps the sun and the electric arc are best known. The sun is so hot, so far beyond our wildest guess, that its temperature is completely unknown. Prof. Paschen considers 5,130 deg. C. the nearest approach to the correct value. In Fahrenheit degrees this is equivalent to 9,266 degrees, a state of incandescence below our expectations.

Helmholz believes a contraction of the sun from its primitive nebulous volume to its present size would give rise to an increase of temperature of 28 millions of degrees, centigrade. Thus it is seen that we have to deal with suggestive estimates which imply conditions natural or constrained, and which in themselves but lead to further inquiry. The heat of the arc is as great a problem as that of the sun. Experiments made by Fizeau and Foucault enabled them to arrive at the conclusion that the intensity of light produced with respect to the sun was expressed by the ratio of 385 : 1000. The temperatures are thus compared in a crude manner. It would seem from these results that a powerful arc light produces a degree of heat which varies from one-quarter to one-sixth of that existing at the sun. Diamonds, graphite and particles of carbon are instantly volatilized, thus showing a heat of thousands of degrees, Fahrenheit.

STREET LIGHTING.

The first evidence of advancing civilization is good street lighting. Its bearing upon the growth of a town and influence in dispelling crime are too well known to need reference here. But aside from all these considerations, towns have been slow in many cases in adopting the most highly developed systems of lighting.

The reason for this has been due to the diversity of opinion existing in regard to the true cost of light. Towns with but a limited sum at their disposal are not apt to plunge into a new expense, however great the benefits, unless the commercial side has been thoroughly investigated. Many places favor the use of gas. In combination with an improved burner, they feel frequently more assured of the expense, and are not torn by conflicting emotions at the idea of a sudden and mysterious death. Such towns, however, are conservative because they lack courage. The established success of electric street lighting has no need of defending its position at present. Towns exist in abundance which feel no fear for the future of electric lighting. None that have failed in its satisfactory utilization can blame anyone but themselves. In a certain section of Orange County, a town has blossomed forth which adopted an old and useless system of electric lighting. Gas would be far more preferable. Yet the people look with pride upon its dim glory and feel a serene joy because their town, as they think, is alive, well lit and prosperous.

GAS RAILWAYS.

There are sources of power today that might be developed to an extraordinary extent. The use of compressed air has been persistently attempted. It is necessary for the public good that the great masses understand the distinction, that constantly requires definition, in the meaning of the word "success." The newspapers are aglow with professional excitement when the news of a new engineering enterprise reaches them. An inflated, unscientific and unsatisfactory account reaches many hungry ears. If an engine run by steam, gas, electricity or compressed air moves, a pæan of joy arises. Columns of enthusiastic predictions appear at once. Commercial success is not considered while the delusion prevails. Perhaps, then, exitement subsides, and the pretty experiment that has inspired so many hopes is seen in the cold, clear light of reason—a scientific success—a commercial failure. Gas for the propulsion of trains has occupied the attention of many competent engineers. It is estimated that the cost of a gas railway would be limited to $26,170 a mile. Roads have been built that did not exceed $28,000 per mile which give excellent satisfaction. While experiments are being made with compressed air it would be interesting to hear of those based upon a more definite experience and using gas. It requires only 32 cubic feet per mile for a ten-horse power car; in all about four cents a mile.

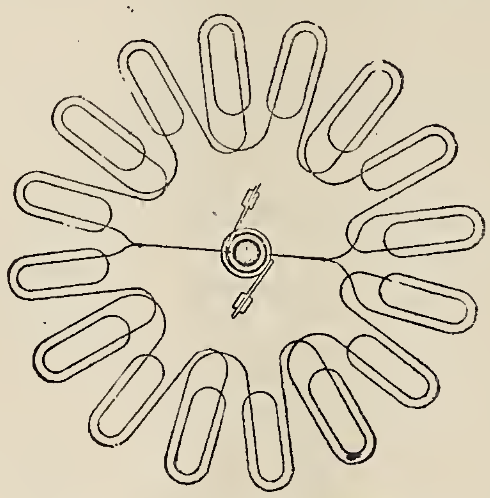
A new process for priming and decorating glass has been invented by Paul Gerard and Gustave L. T. des Paturelles. The surface of the glass is coated with ordinary collodium or a solution of nitro-cellulose in a dissolvent. When the dissolvent has evaporated there remains upon the glass a very adhesive cellulose layer, transparent and capable of receiving any kind of decoration by impression, painting, dyeing, gilding, etc. The collodium can be colored at the start by means of colors soluble in alcohol and in the dissolvent used for the cellulose. Hereby an inherent colored layer is produced on the glass, and if the latter is transparent the product resulting from this process can be substituted advantageously for glass colored in the batch. This process can be applied successfully to metals, marble, porcelain and other pottery.—American Manufacturer.

ALTERNATING CURRENTS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

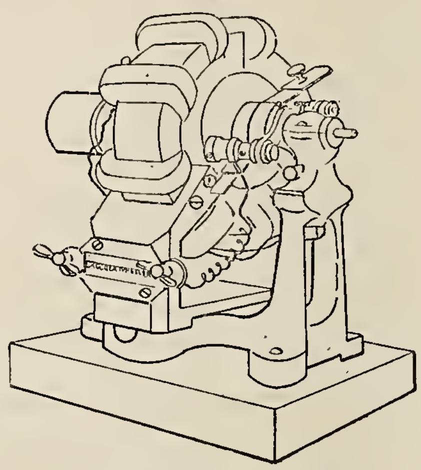
BY NEWTON HARRISON, E. E.

In the many applications of power to various industries none have so occupied the attention and interest of engineers as the use of alternating currents. Years ago the alternator was accepted as a simple device for the generation of reversing currents. Its comparative cheapness of construction and ease of operation have always placed it foremost as the basis of a power plant stretching over rough and rugged countries where attention and skill are of the lowest order. Jablochkoff invented his historic candles for alternating currents and thereby drew attention to its usefulness for arc lighting. In its varied applications we meet with many unique effects. It is striking to notice the results obtained by applying it for the production of light and power and the remarkable developments that have issued from the many attempts to produce a constant and steady light, a self-starting and independent source of power. These problems have gradually reduced the field of alternating-current work to certain constricted lines.



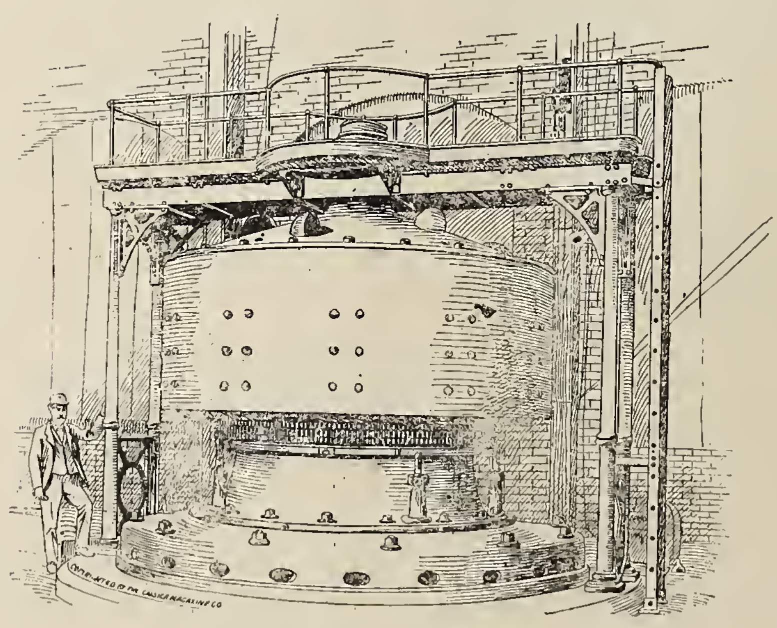
ARMATURE WINDING OF ALTERNATOR.

The labors of the past do not partake of the brilliant successes of the present. Continuous and alternating currents stand side by side as indispensable power factors, to be individually applied according to the circumstances, each with its own peculiar set of apparatus designed and perfected to perform its special work.



MODEL ALTERNATOR.

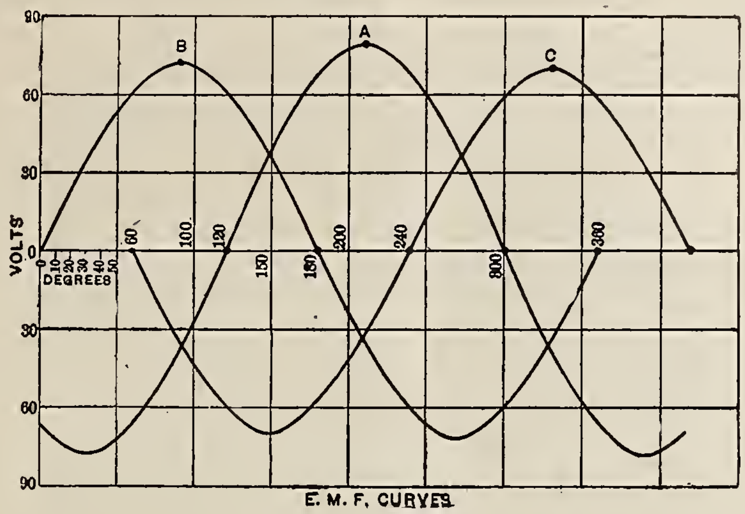
It is then necessary to accept the achievements of the past as but the beginning of a vast engineering revolution, the final outcome of which will be a new and infinitely more economical means of illumination and a cheaper source of power.



NIAGARA GENERATOR

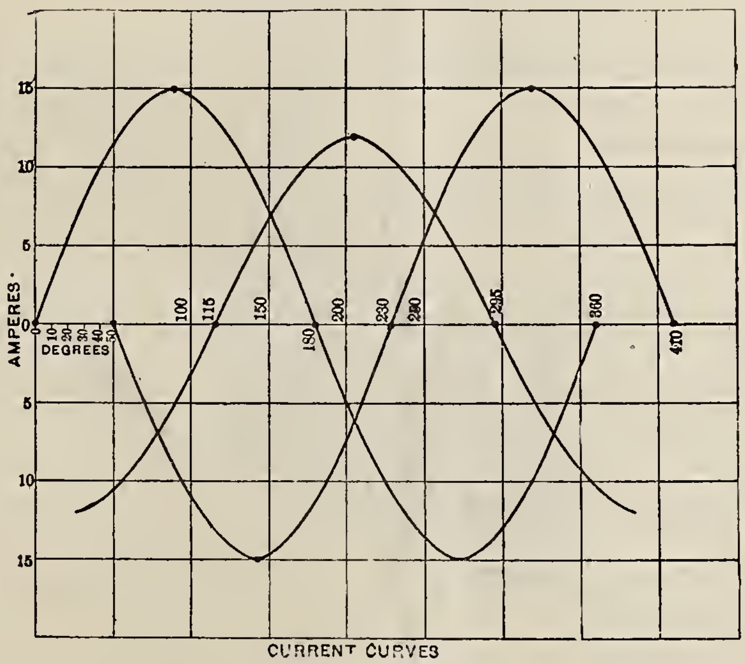
An alternating current is one in which the flow of elec-

tricity is constantly reversing. It rises to a high value like an ocean wave and recedes, growing again in the opposite direction in a similar manner. The growth of the current and its reversal in this peculiar manner is due to the arrangement of the lines of force when cut by a revolving conductor. In the alternator a series of poles are arranged around a common centre pointing inwards. As a conductor passes in front of them, each pole creates within the wire a wave of electromotive force. When the wire passes in front of the north pole the rise and fall of current is the reverse of what it would be in front of a south pole. These poles are always some multiple of two—either four, six or eight poles, etc. Therefore we have as many north as south poles. The conductor develops while rotating a continued succession of rapidly reversing waves of electricity, which have earned the name of alternating currents.

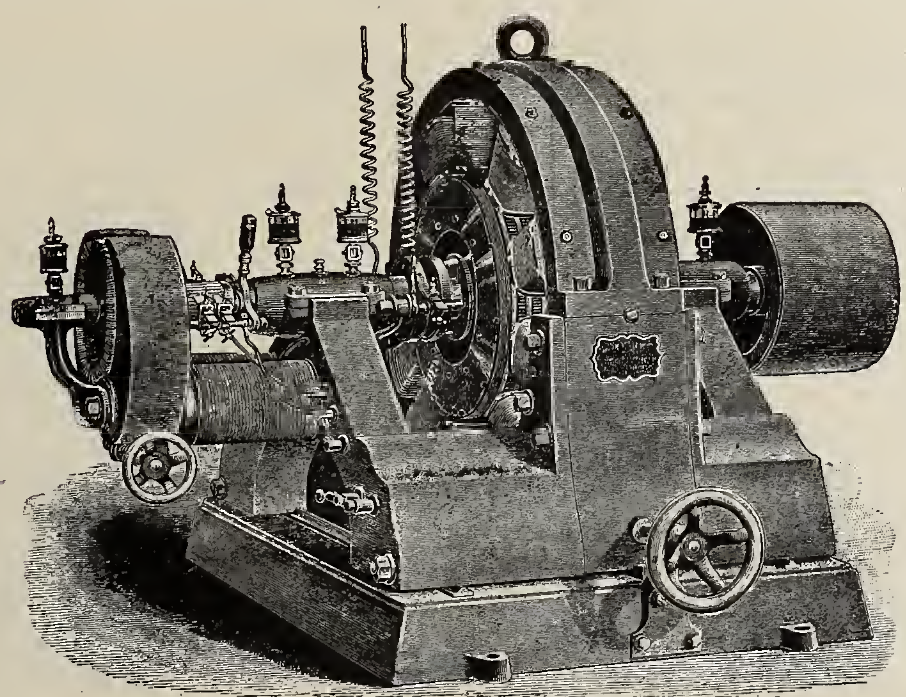


E. M. F. CURVES.

Frequency.—The rapidity with which these waves reverse back and forth is called their frequency. If a wire passes in front of a south pole the current rises and falls, but *does not reverse* in direction. If continued past a north pole, the reversal does occur; it is therefore necessary for the wire to pass before two unlike poles to provide a rise and fall and a reverse rise and fall.



CURRENT CURVES

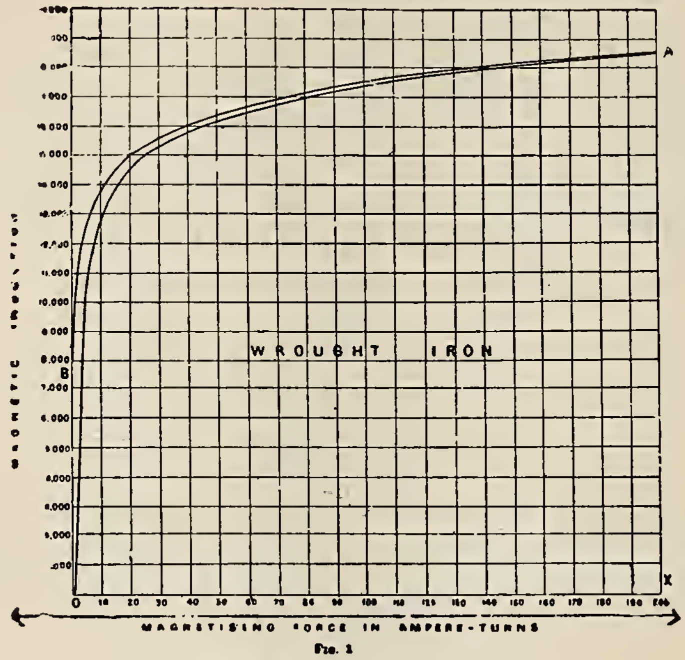

SELF-CONTAINED ALTERNATING CURRENT GENERATOR.

Period.—This constitutes a complete current wave. It is called a period. The number of periods are dependent

upon the

Number of pairs of poles.
Speed of the dynamo.

To calculate the number of periods in an alternator we observe the following rule:

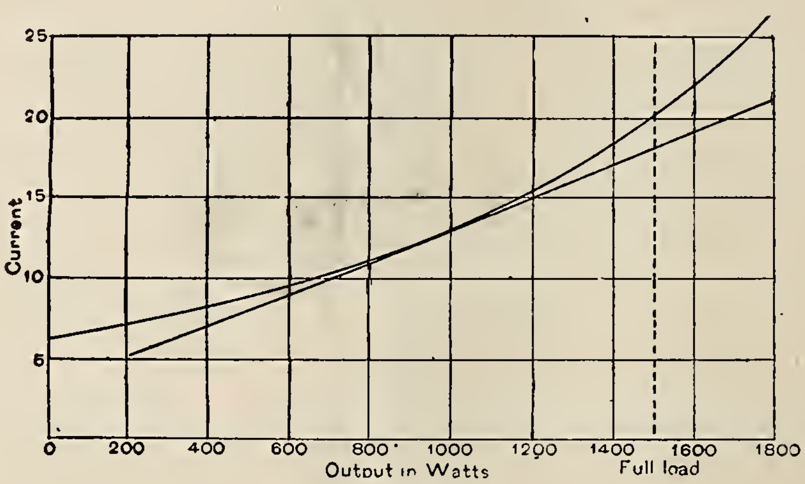


CURVE OF MAGNETISATION.

Number of periods = one-half of the poles $\times$ revolutions per second.

Take a dynamo having poles = 8
speed = 1,200.

Periods = 4 $\times$ 20 = 80 per second.



POWER CURVE.

Phase.—The rush of electromotive force through a wire is such that the entire electrical influence does not pervade it until an instant afterwards. The current does not instantly flow; a certain inertia, as it were, prevents it. The retarding influence may be either the resistance or the self-induction of the circuit.

While it is true that an electric current requires both pressure and amperes to properly deserve the name, it is possible to imagine, upon the closing of a circuit, the electromotive force at work almost at once, as though it were merely a static effect and the current requiring an exceedingly short interval afterward to follow it. In other words, pressure or potential arrives at a given point and affects it before current. The interval elapsing is called the difference of phase. There are two ways of regarding it—as an interval of time or as an angle of difference. To our minds' eye the first is preferable, as it supplies a physical something within the grasp of all.

Impedance.—The retarding effects of resistance and self-induction give rise to a condition called impedance. The circuit acts as if affected by a heavy resistance; the current is restrained from flowing, and without any great consumption of energy the flow is choked. The frequency also gives rise to this condition to a greater extent than self-induction.

ELECTRIC MOTORS IN SHOP WORK.

The employment of electric motors, so arranged that they may be readily moved from point to point in the shop, as occasion may demand their services, is spreading with considerable rapidity both in Europe and in America. By this method the power is conveyed without trouble to any desired locality, the necessary connections are quickly made, and the results are eminently satisfactory in every respect. In a recent American installation, the motor is used in this way, in an establishment engaged in the building of heavy special and standard tools. The main shop is about 500 feet long by 70 feet wide, and at each side, extending the entire length, is a bay about 25 feet wide. The entire length of the central portion of the building is traversed by electric cranes. The electric conductors feeding the crane motors are tapped at the columns, where the necessary connecting devices are put in. Four portable electric motors, ranging from two to eight horse power, are in use. The smallest is arranged for drilling and tapping, and is provided with all the attachments needed for securing it in working position on the piece to be drilled. This motor can be carried about the shop by hand. The large motors are mounted upon heavy bases, and are geared down so as to drive a pulley at the speed of the main driving shaft. They also have in the upper part of their frame, rings by means of which they may be lifted and moved by the travelling cranes as required. The motors are self-contained machines in every respect, and are furnished with all the electrical devices necessary for their control and operation. The convenience of this equipment and the ease and rapidity with which the motors can be moved and connected for working can be best illustrated by the statement that in one day one of the large motors can be, and has been, used on three different machines in as many different locations.

INTERIOR CONDUIT AND INSULATION CO.

The recent Electrical Exposition aroused New York and the neighboring precincts to the fact that electrical engineers were booming. People speak of art galleries and flower shows, of horse fairs and crystal mazes; they are pretty exciting, no doubt, but don't hold a candle to some choice corners of the past exhibition. The Interior Conduit and Insulation Company were alive every night of the show. They had a first-class exhibit showing their famous interior conduit, dental outfits and elegantly finished motors.

The illustration gives one an idea of what it looked like. Motors were there of all sizes, from the little fan to those of several thousands of pounds in weight, and dynamos to run all the way from 10 to 500 lights. The beautiful arrangement of the machines gave an excellent chance to the technical visitor to give them a thorough inspection. As models of compactness and skilful design they represent the trained effort and commercial success of a most substantial firm. The Interior Conduit and Insulation Co. know when they have a good thing and they push it along. Factory and offices, No. 529 West 34th street, New York.

NEW THEATRE DIMMER.

The Ironclad Rheostat Co., of Westfield, N. J., have placed a line of new goods on the market. Their rheostats are made entirely of cast-iron, inside of which, hermetically embedded and sealed in a solid insulating material, are the resistance wires.

These are so disposed that, while thoroughly insulated from, they are in the closest possible juxtaposition to the iron shell.

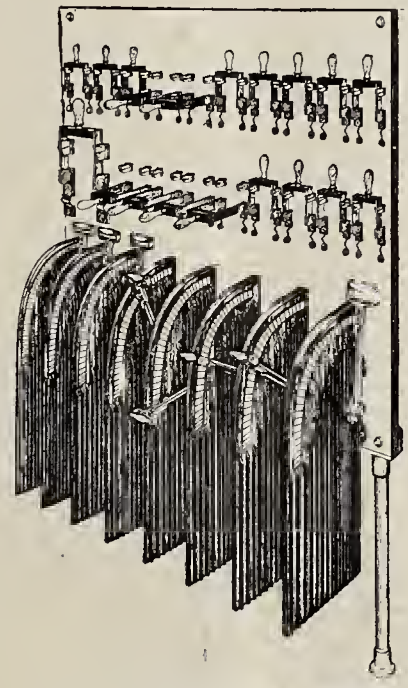
This shell acting as a radiator, safely and rapidly dissipates the heat caused by the electric current passing through the resistance wires.

They are particularly designed for the limited space in the wings of a theatre, taking up no more room than the switch alone of the old style dimmers.

The throw of the switch is so proportioned that (where several dimmers are installed) any or all of the dimmers may be thrown in simultaneously.

Large dimmers are made up of two or more plates bolted together and connected in series, the terminals of the steps being brought to the contacts on the face plate.

The steps are graduated so that the lamps will be dimmed gradually and the light reduced to one-sixth of the full candle-power.



GROUP OF THEATRE DIMMERS.

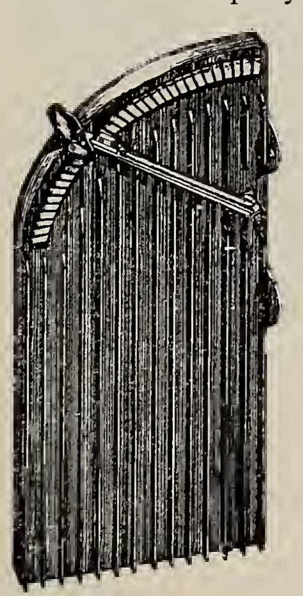
These dimmers are intended to supply the demand for dimmers, which have more steps than their standard 21-step dimmer, and they will be equipped with switch-handles which operate in 90° of the circle, giving maximum effect with the minimum movement of the switch. These dimmers are made by the same process as their several other standard styles of dimmers, and they confidently expect that they will fill a long felt want for a low priced dimmer with increased number of steps.

With this new type of dimmer they now have the most complete line of theatre dimmers in the market, and are prepared to furnish any sizes and any combinations.

Particnlar attention also may be called to the fact that they build special theatre dimmers singly or in banks with fifty-five steps equipped with interlocking switches.

ELECTRIC CAR MOTOR PATENT.

In the United States Circuit Court, Boston, yesterday, a bill was filed in equity, which is brought by the Thomson-Houston Electric Company against the Gloucester, Essex and Beverly Street Railroad Company, claiming that the defendant is infringing upon patent No. 457,102 granted to Norman G. Bassett for electric car motors.—Salem (Mass.) "Gazette."



IRON-CLAD RHEOSTAT.

Baltimore, Md.—The Central Railway Company will erect a new power house and remove its present plant to the same. A new power plant, machinery, etc., will be contracted for. Address G. Blakiston, president.

Asbury, Park, N. J.—The Atlantic Coast Electric Railway Co. and the West End and Long Branch Railway Co., which control the electric road between Pleasure Bay and Asbury Park, have been consolidated.

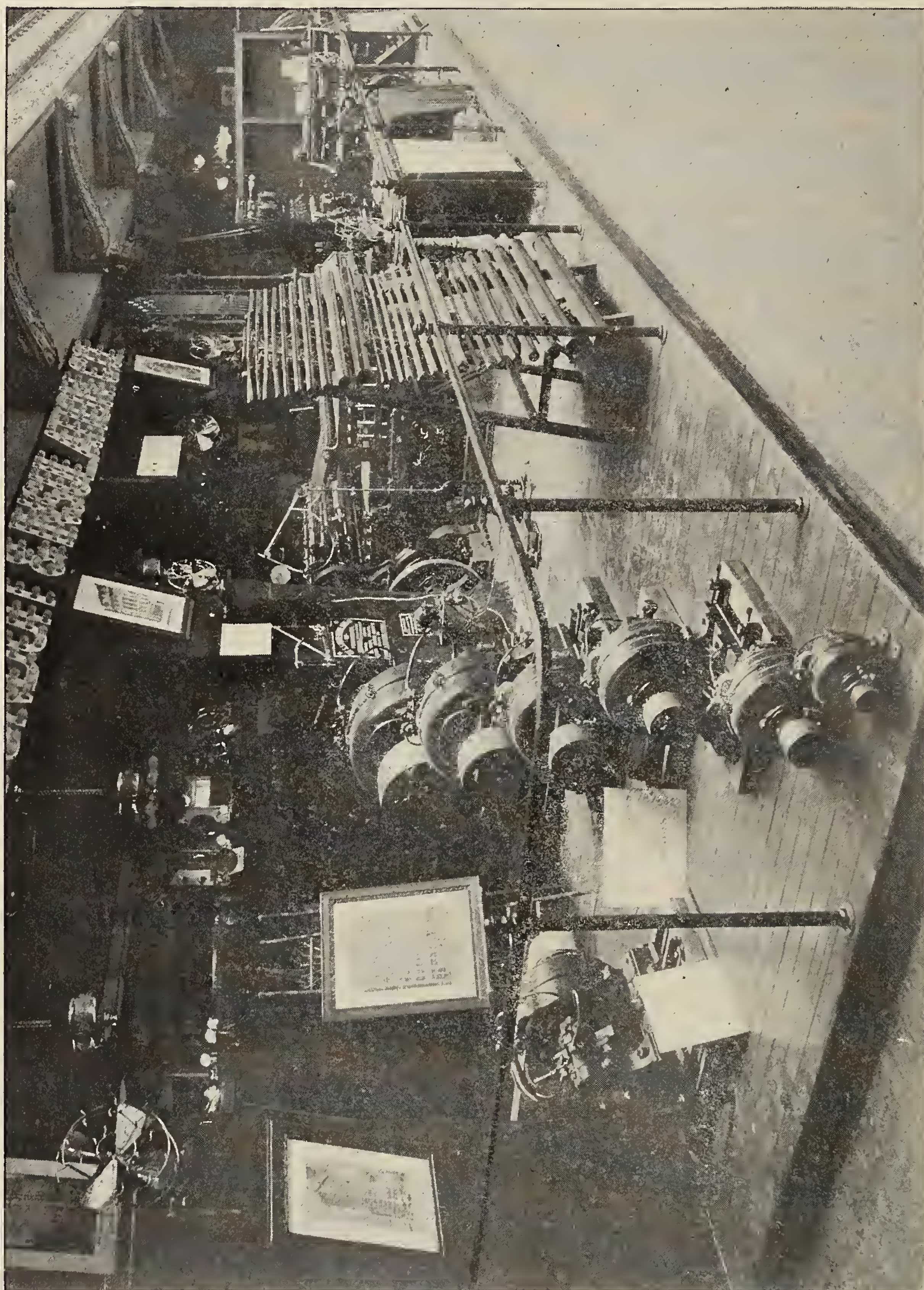
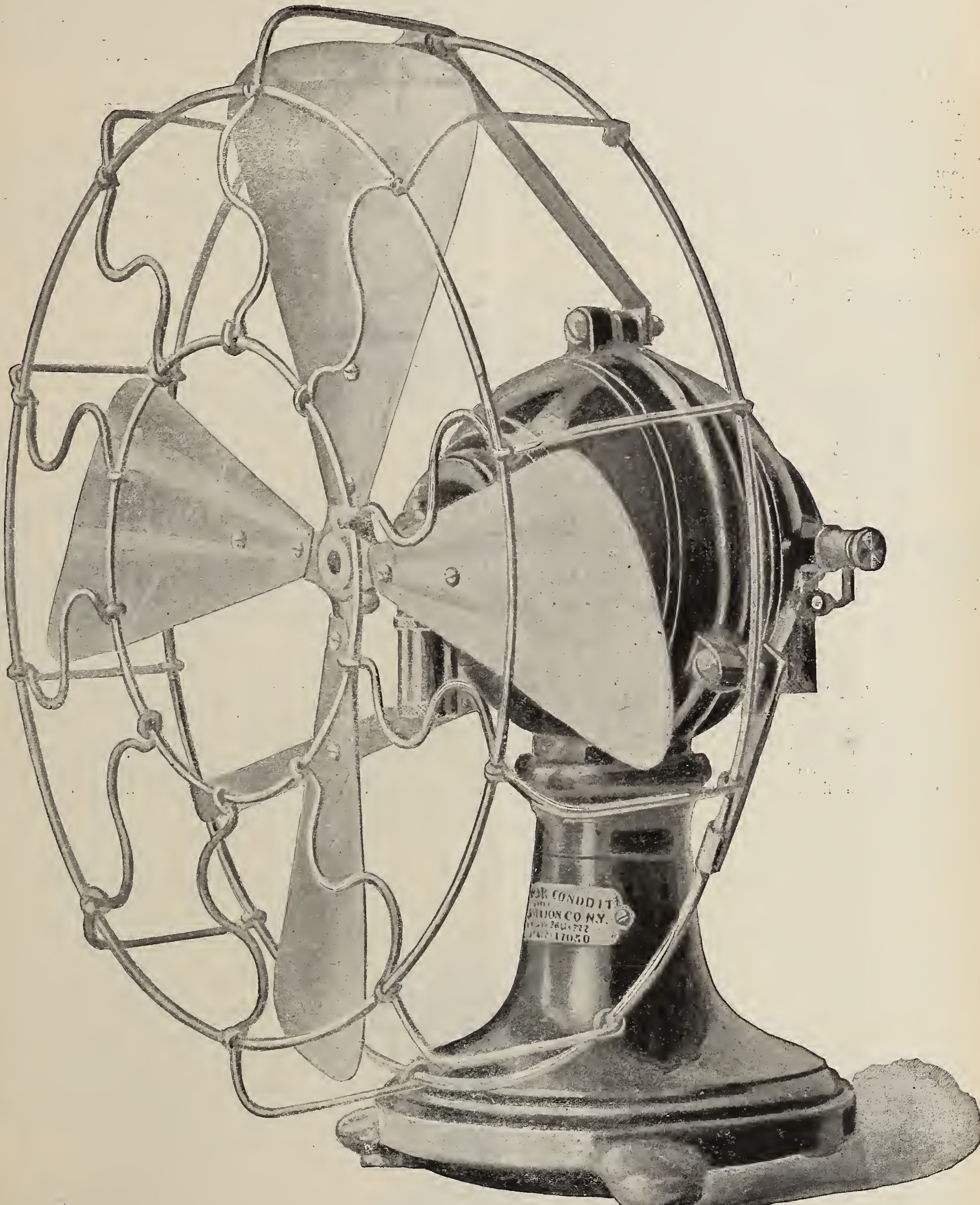


EXHIBIT SHOWING LUNDELL MOTORS, DENTAL OUTFITS AND SAMPLES OF INTERIOR CONDUIT.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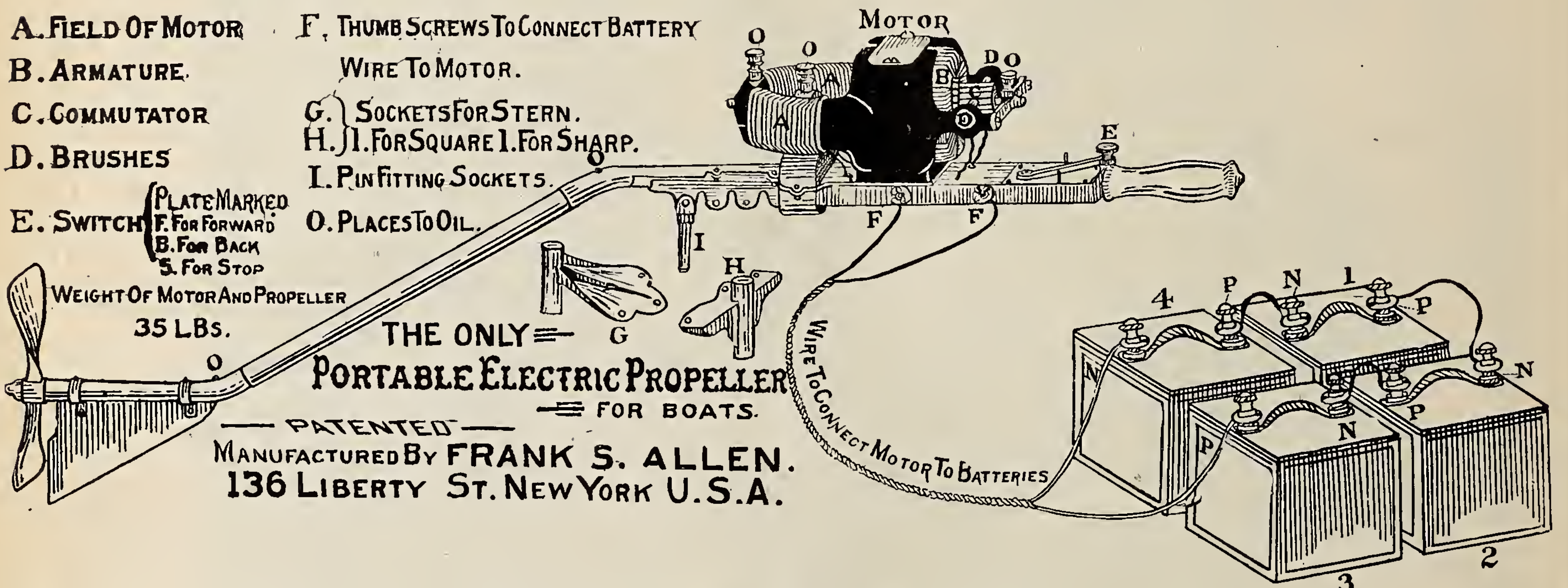
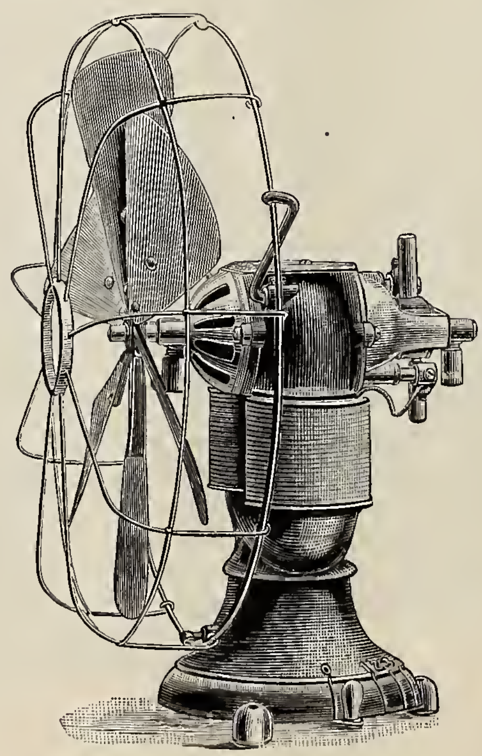
PORTABLE ELECTRIC PROPELLER.

One of the most ingenious devices ever made for the comfort of country and suburban residents is manufactured by Frank S. Allen, of 136 Liberty street, New York. Many an enterprising individual has tried to build an electric launch, and gloried in the thought of its silent power moving him swiftly through the water. Moonlight on the lake isn't in it with an electric propeller attachment. This ingenious little invention can be applied to any boat. A few cells of battery, which cause no trouble at all, a rudder and motor in one, and the deed is done. The little screw cuts through the water, driven by the potent electric current, without even a murmur. This is the thing for the promotion of happiness. Call on the inventor. You wont be able to resist ordering one and recommending it to all your friends. The address is above, 136 Liberty street.



THE ECK FAN MOTOR.

The Eck improved fan motor, manufactured by C. A. Eck, No. 116 Wooster street, N. Y., is an excellent sample of the latest and best design in electric fans. It has wrought-iron field cores and an ironclad armature.



ECK IMPROVED FAN MOTOR.

All the parts are guaranteed to be perfectly well insulated, thoroughly ventilated and protected in every respect.

The bearings are up to date, being self-oiling, and the self-feeding carbon brushes and finely finished commutator leave nothing to be desired. The external parts are heavily nickeled and japanned, thus giving it a most attractive appearance. The field coils are series wound with green covered wire. The rheostat is made of german silver wire insulated by asbestos and mounted on a slate switchboard conveniently hidden within the base. The motor has three speeds, giving perfect satisfaction to the trade and to thousands of customers that at present use them.

WESTERN TELEPHONE CONSTRUCTION CO.

W. W. Bostwick, Jr., New York agent for the Western Telephone Construction Co., No. 38 Park Row, gives us the encouraging news that a large business is being done by his company. He has just closed a nice order from the Garvin Machine Co., of New York, for thirty-drop multiple circuit switchboard and complete telephone outfits. He has several other large plants under way. In the American Book Co., New York, they have installed a twenty-five drop plant. Several other large establishments are using their goods and feel highly satisfied with their investment. The apparatus is first-class, finely finished and in every sense a great convenience. At Richmond, Va., an exchange of two thousand telephones has been installed. At Fort Wayne, Ind., between one thousand and fifteen hundred telephones have been set up in an exchange. At LaCrosse, Wis., they took out a

nine-hundred drop exchange and replaced it with the Western Telephone Exchange.

This company installed the one hundred and fifty-telepone equipment in the Interior Department at Washington, D. C. Several of the daily papers mentioning this plant were ignorant at the time of the manufacturers. With the great success they have had, a splendid future lies before them.

POSSIBLE CONTRACTS.

New York City.—Preliminary papers have been signed for the sale of the St. James Hotel property, at the southwest corner of Broadway and 26th street. The buyers are Philadelphians, who propose to erect a sixteen-story office building to cost $1,500,000. Architect Bruce Price has been commissioned to draw the plans.

Lakewood, O.—The special election held in Lakewood, to determine whether the hamlet should be bonded for $20,000, to purchase an electric light plant, was carried. The plant will be erected as soon as possible. It will provide 80 arc lamps and 1,000 incandescent lamps, the entire plant to cost $20,600. Wm. F. Classe, clerk.

New York City.—Ground is soon to be broken for the new building for the New York Medical College and Hospital for Women, at 79th street and 8th avenue.

New York City.—The Gas Engine and Power Company will erect a two-story iron and steel boiler house and machine shop at Morris Dock, Morris Heights, at a cost of $30,000.

Ocala, Fla.—The time for receiving bids for the electric light plant at Ocala has been extended to August 20.

Barnesville, Ga.—$7,000 in bonds will be issued to put in an electric light plant at Barnesville.

Chicago, Ill.—Marshall Field, who gave $1,000,000 to found the Field Museum, announces that he will give $2,000,000 more to provide a suitable home for the museum on the lake front.

John Jacob Astor, 23 West 26th street, has in contemplation the construction of an apartment hotel at the southeast corner of Fifth avenue and 55th street.

The Central Syndicate Building Co. will erect a fine fifteen-story building on the northeast corner of Broadway and Pearl street. J. T. Williams has been appointed the supervising architect.

Trenton, N. J.—The new wing and hospital at the state prison will be entirely completed in about ten days. The commission is about to take up the consideration of a new lighting plant.

Vallejo, Cal.—Bids will be opened August 19 for the construction of an electric plant at Vallejo.

Albany, N. Y.—The Albany Railway Co. will extend its lines to Cohoes, and has already made application to the authorities of Colonie for permission to extend the tracks of the company through the town. The approximate cost of the new line will be about $125,000.

Norfolk, Va.—The First Presbyterian Church will be fitted out with electric lights, and an electric motor will also be installed for the organ.

Pottsville, Pa.—A complete electric lighting plant will be installed in the new building now being erected by Dives, Pomeroy & Stewart.

NEW CORPORATIONS.

Zanesville, O.—The Zanesville Street Railway and Electric Company was incorporated with a capital of $500,000.

Cleveland, O.—The Northeastern Railway Co., incorporated. Incorporators, Frank S. Lickens, Charles N. Sheldon, William D. Bennett and others. Capital, $100,000. They will build an electric line from the north of Euclid Ave. throngh Lake, Cuyahoga and Summit Counties to Hudson.

New York City.—The American Engineering Works, to manufacture and deal in machinery and gas and electric apparatus. Capital, $5,000. Directors, Frank M. Ashley of Brooklyn, and John J. Hankenhof of New York City.

Syracuse, N. Y.—The Onondaga Lake Railroad Company was incorporated to construct a double track street railroad about seven miles in length from Clinton Square, in Syracuse, to the resort known as Long Branch. Capital, $250,000. Incorporators, John S. Kaufman, W. R. Smith and others.

Bath, Me.—The Car Trolley Head Company, for the purpose of purchasing and controlling appliances for building, improving and operating electric railways and rolling stock. Capital, $100,000. President, Warren H. Carr of Bath; Treasurer, Charles R. Donnell, of Bath.

TELEPHONE NOTES.

Baltimore, Md.—In accordance with the ordinance granted by the City Council the Home Telephone Co. is now preparing to contract for the construction of its system. Address W. J. Atkinson, Manager.

Kansas City, Mo.—A franchise for a telephone system has been applied for by D. A. Williams and associates. It is said that they represent the Standard Telephone Co., of Wisconsin.

Evansville, Ind.—The Cumberland Telephone Company is making arrangements to extend its wires from this city to all of the surrounding towns of any importance.

NEW TELEPHONE COMPANIES.

Bellefonte, Pa.—The North and West Branch Telephone Co. It will operate a system of lines to be constructed in the counties of Clinton, Lycoming, Northumberland, Montour, Columbia, Luzerne and Lackawanna. Capital, $50,000. Directors, Monroe H. Kulp, W. W. Ryon, J. O. Shipman of Shamokin, and others.

Waynesburg, Pa.—A charter has been granted the Waynesburg Bluff and Cameron Telephone Company. Capital, $2,000. The company will build a telephone line from Waynesburg, via. Bluff, Higbe and Sugar Grove to Cameron, W. Va.

Albany, N. Y.—The state is to construct a telephone line between Albany and Buffalo, along the Erie canal, so that the division and section superintendents, lock tenders, patrolmen and watchmen can readily communicate with one another and Superintendent Aldrige's office in Albany.

TELEPHONE PATENTS.

ISSUED JULY 7, 1896.

563,240. Multiple Switchboard System for Telephone Exchanges. Oro A. Bell, Brooklyn, N. Y. Filed May 19, 1892.

563,318. Bridging Bells. Charles E. Scribner, Chicago, Ill. Filed March 6, 1891.

563,320. Multiple Switchboard for Telephone Exchanges. Charles E. Scribner, Chicago, Ill. Filed March 5, 1892.

563,321. Incandescent Lamp. Charles E. Scribner, Chicago, Ill. Filed May 9, 1893.

563,322. Telephone Circuit. Charles E. Scribner, Chicago, Ill. Filed June 16, 1893.

563,323. Testing Apparatus for Multiple Switchboards. Charles E. Scribner, Chicago, Ill. Filed November 13, 1893.

563,327. Telephone Exchange Switchboard. Charles E. Scribner and Ernest P. Warner, Chicago, Ill. Filed February 7, 1890.

563,352. Individual Calling Apparatus. William W. Alexander, Kansas City, Mo. Filed April 8, 1893.

563,393. Telephone Transmitter. William A. Moore, Brooklyn, N. Y. Filed March 25, 1896.

563,614. Telephone System. Jean Piel, New York, N. Y. Filed April 13, 1896.

563,692. Telephone Signaling Circuit. John S. Stone, Boston, Mass. Filed March 18, 1896.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued July 7, 1896.

563,254. Electric Railway. Henry Brandenburg, Chicago, Ill. Filed April 16, 1895.

563,257. Lightning Arrester and Automatic Fuse Block. Thomas L. Carleton, New Orleans, La. Filed February 28, 1894.

563,269. Combined Annunciator and Fire Alarm. Manious Garl. Akron, Ohio. Filed September 27, 1894.

563,273. Means for Insulating Electric Conductors. Theodore Guilleaume, Mulheim-on-the-Rhine, Germany. Filed March 19, 1895.

563,274. Electric Cable. Theodore Guilleaume, Mulheim-on-the-Rhine, Germany. Filed November 2, 1895.

563,282. Electric Railway. Eduard Lachmann, Hamburg, Germany. Filed June 30, 1894.

563,288. Electrical Production of Chemical Reactions. Walter Lobach, Chicago, Ill. Filed November 30, 1894.

563,290. Method of Automatic Current Regulation of Dynamo-electric Machines. Frederick H. Loveridge, Coldwater, Mich. Filed August 6, 1894.

563,294. Apparatus for Selective Signal Systems. Frank R. McBerty, Downer's Grove, Ill. Filed August 23, 1895.

563,304. Electrically Controlled Boat-Steering Apparatus. Charles E. Ongley, New York, N. Y. Filed December 20, 1892.

563,315. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill. Filed January 2, 1883.

563,316. Speed-regulator for Dynamos. Charles E. Scribner, Chicago, Ill. Filed December 10, 1888.

563,317. Speed-regulator for Dynamos. Charles E. Scribner, Chicago, Ill. Filed December 10, 1888.

563,319. Incandescent Lamp. Charles E. Scribner, Chicago, Ill. Filed July 20, 1891.

563,324. Electric Police-signal System. Charles E. Scribner, Chicago, Ill. Filed May 14, 1894.

563,326. Contact Point for Electrical Instruments. Charles E. Scribner, Chicago, Ill. Filed August 17, 1895.

563,329. Process of Building up Carbon Filaments. Frank S. Smith, Pittsburgh, Pa. Filed August 29, 1892.

563,335. Circuit-re-establishing Cut-out. Albert L. Tucker and Frederick H. Loveridge, Chicago, Ill. Filed August 8, 1895.

563,336. Electric Signaling Apparatus. Frederick W. Turner, Newton and Winthrop M. Chapman, Needham, Mass. Filed April 18, 1891.

563,342. Cable Terminal Attachment. Arthur T. Welles, Chicago, Ill. Filed March 3, 1896.

563,379. Flexible Mica Insulating Sheet. Charles W. Jefferson, Schenectady, N. Y. Filed March 16, 1895.

563,407. Electric Switch. Charles G. Perkins, Hartford, Conn. Filed April 1, 1896.

563,425. Power Gearing for Electric Cars. Elmer A. Sperry, Cleveland, Ohio. Filed June 9, 1894.

563,426. System of Electrical Distribution. Charles P. Steinmetz, Schenectady, N. Y. Filed January 30, 1895.

563,427. Compound-wound Multiphase Generator. Chas. P. Steinmetz, Schenectady, N. Y. Filed March 19, 1896.

563,428. Storage Battery. William J. Still, Toronto, Canada. Filed September 18, 1894.

563,440. Electric Motor. Ernst J. Berg, Schenectady, N. Y. Filed October 8, 1895.

563,442. Electrical Signaling Apparatus. Samuel S. Bogart, Schraaleuburg, N. J. Filed October 16, 1894.

563,443. Electrical Selector. Samuel S. Bogart, Schraalenburg, N. J. Filed January 5, 1895.

563,453. Magneto-electric Machine. Peter J. Crouse and Ellsworth W. Milgate, Utica, N. Y. Filed September 7, 1895.

563,474. Automatic Fire Alarm. Joseph W. Frost, New York, N. Y. Filed February 18, 1888.

563,475. Thermostat and Circuit Therefor. Joseph W. Frost, New York, N. Y. Filed March 28, 1890.

563,482. Insulating Support for Rails of Electric Railways. Patrick Haley, Chicago, Ill. Filed March 9, 1896.

563,491. Electric Tunneling Machine. Herbert R. Keithley, Chicago, Ill. Filed May 21, 1892.

563,527. Process of Producing Calcium Compounds. Thomas L. Wilson, New York, N. Y. Filed March 16, 1893.

563,531. Trolley-catcher. Charles F. Wilson, Brooklyn, N. Y. Filed March 6, 1896.

563,575. Reversing Controller for Electric Motors. Alva C. Dinkey, Munhall, Pa. Filed September 3, 1895.

563,586. Automatic Repeater. Joseph W. Frost, New York, N. Y. Filed August 16, 1892.

563,599. Magneto-electric Generator. Arthur G. Leonard, New York, N. Y. Filed August 10, 1894.

563,600. Rheostat for Electric Motors. Harry W. Leonard, New York, N. Y. Filed June 21, 1895.

563,716. Electrical Insulating Sheet. Charles W. Jefferson, Schenectady, N. Y. Filed November 23, 1895.

The Electrical Age.

Vol. XVIII., No. 7 NEW YORK, AUGUST 15, 1896. Whole No. 483

FACTORY OF SNOW STEAM PUMP CO.

THE SNOW STEAM PUMP CO.

Comment can be created by the use of two mediums—the ludicrous and the beautiful. In New Orleans the grand fete of the Mardi Gras is a combination of the grotesque and the superb. It is famed throughout the world. Comment means in a certain sense popularity, from which springs revenue to those that have purposely excited it and possess the means by which to retain it. Let us be more definite. The Snow Steam Pump Company, of Buffalo, N. Y., have issued one of the most beautiful catalogues it has ever been our pleasure to receive. As a work of art, it would excite the comment we speak of; as a treatise on pumps written in a deeply interesting manner, without the technicalities of trade, it stands unequalled. We shall cherish their catalogue in our minds as a model of refined advertising, as a work of art, as a means brought to bear upon the higher faculties with all the pleasing effects of a well written and beautifully executed volume. Let us turn to other equally important factors in their progress and hear about their business management.

The Snow Steam Pump Co. are thoroughly well represented in this city by a staff of experts at No. 126 Liberty street, N. Y. Mr. D. H. Gildersleeve, the New York representative, is an able mechanical engineer and thorough business man. Assisted by a competent corps of associates, the application of the Snow Steam Pump Co.'s goods for all kinds of power plants are well shown by Mr. Gildersleeve. We take pleasure in mentioning the names of these assistants: R. R. Brown, R. C. Oliphant and Louis D. Gumpert. J. F. Holloway is consulting engineer. A great deal of lively hustling is going on and the orders are

piling in. The Middle and part of the Eastern States are being well canvassed by these gentlemen. A full line of these well-known pumps are kept at their warehouse in West street, New York, ready for immediate shipment. All the Metropolitan Traction Company's four power-houses are equipped with Snow pumps.

The cuts show the interior of their great works in Buffalo, N. Y., and the various styles of pumps that are applicable to electric light, power and railway steam plants.

LORD KELVIN.

At the banquet given to Lord Kelvin by the Corporation and University of Glasgow on the evening of June 16, he spoke (according to the report in the London "Times") as follows:

"I thank you with my whole heart for your kindness to me this evening. You have come here to commemorate the jubilee of my university professorship; and I am deeply sensible of the warm sympathy with which you have received the kind expressions of the Lord Provost regarding myself in his review of my fifty years' service and his most friendly appreciation of practical results which have come from my scientific work. I might, perhaps, rightly feel pride in knowing that the University and City of Glasgow have joined in conferring on me the great honor of holding this jubilee, and that so many friends and so many distinguished men, friends and comrade-day-laborers in science have come from near and far to assist in its celebration, and that congratulations and good wishes have poured in on me by letter and telegram from all parts of the world, I do feel profoundly grateful. But when I think how infinitely little is all that I have done I cannot feel pride; I only see the great kindness of my scientific comrades and of all my friends, in crediting me for so much. One word characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly during 55 years; that word is failure. I know no more of electric and magnetic force or of the relation between ether, electricity and ponderable matter, or of chemical affinity, than I knew and tried to teach my students of natural philosophy 50 years ago in my first session as professor. Something of sadness must come of failure; but in the pursuit of science inborn necessity to make the effort brings with it much of the *certaminis gaudia*, and saves the naturalist from being wholly miserable, perhaps even allows him to be fairly happy, in his daily work. And what splendid compensations for philosophical failures we have had in the admirable discoveries by observation and experiment on the properties of matter, and in the exquisitely beneficent applications of science to the use of mankind with which these 50 years have so abounded! You, my Lord Provost, have remarked that I have had the good fortune to remain for 50 years in one post. I cordially reply that for me they have been happy years. I cannot forget that the happiness of Glasgow University both for students and professors is largely due to the friendly and genial city of Glasgow in which it lives. To live among friends is the primary essential of happiness; and that, my memory tells me, we inhabitants of the university have enjoyed since I first came to live in it in 1832, 64 years ago! And when friendly neighbors confer material benefits, such as the citizens of Glasgow have conferred on their university, in so largely helping to give it its present beautiful site and buildings, the debt of happiness due to them is notably increased. I do not forget the charms of the old college in the High street and Vennel. Indeed, I remember well when in 1839 the old natural philosophy class-room and apparatus-room (no physical laboratory then) was almost an earthly paradise to my youthful mind. And the old College Green, with the ideal memories of Osbaldistone and Rashleigh and their duel, created for it by Sir Walter Scott, was attractive and refreshing to the

(Continued from Page 456.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—CARBON CONSUMING BATTERY.

New Orleans, July 30, 1896.

Electrical Age Pub. Co.

Dear Sirs :—Being very much interested in your Inquiry Column, I would be happy to be informed of the following questions : Does the carbon consume in the new battery of Dr. Jacques? Is the cell more economical than a steam-engine? Kindly oblige with answer.

Yours, faithfully,

Francis A. Cleves.

(A.)—The battery spoken of actually consumes carbon, according to the test published in the Electrical Age of previous issue. Its efficiency is considerably greater than that of a steam-engine, being calculated to be about 80 per cent. Were it even 40 or 50 per cent., and less expensive than *burning* coal, its use would be generally popular.

(Q.)—SEA WATER BATTERY.

Patchogue, August 2, 1896.

Editor of Electrical Age.

Dear Sir :—Is there any reason why a boat propelled by the power from salt water batteries should not succeed? I have made an outfit and will install the motor this week. I expect a heavy current, as my batteries have large copper and zinc plates and dip directly into the sea water.

Yours, respectfully,

R. L. Franz.

(Q.)—GAS ENGINE FOR DYNAMO.

Atlanta, Ga., July 18, 1896.

To Editor Electrical Age:

Dear Sir:—Thanking you in advance for your kindness, will you please answer this question: Can a steady light be obtained by a gas engine and dynamo plant? Is the amount of light obtained more than if the gas was burned direct? I am exceedingly anxious to know because my store needs lighting, on account of competitors, and I can take care of a gas engine. Yours truly,

Elmira Cutting.

(A.)—A steady light can be obtained if a good gas engine is used. More light is obtained when gas drives a dynamo than when it is burned in tips. A 5-HP. plant will pay you to install.

(Q.)—LIGHTNING.

Atlantic City, July 21, 1896.

Electrical Age:

Dear Sir:—I am the proprietor of a hotel out here, and feel that I ought to give my guests the best protection possible. The lightning came forking around here last week and gave everyone a scare. I am going to put up lightning protectors all over, but don't know where to get them. By letting me know you will greatly oblige

Yours truly, August Simmer.

(A.)—Lightning rods can be procured at No. 44 Broad street, New York General Electric Co. Place them at the most prominent points of the house when installing them.

(Q.)—CLOSED GLOBE ARC LAMPS.

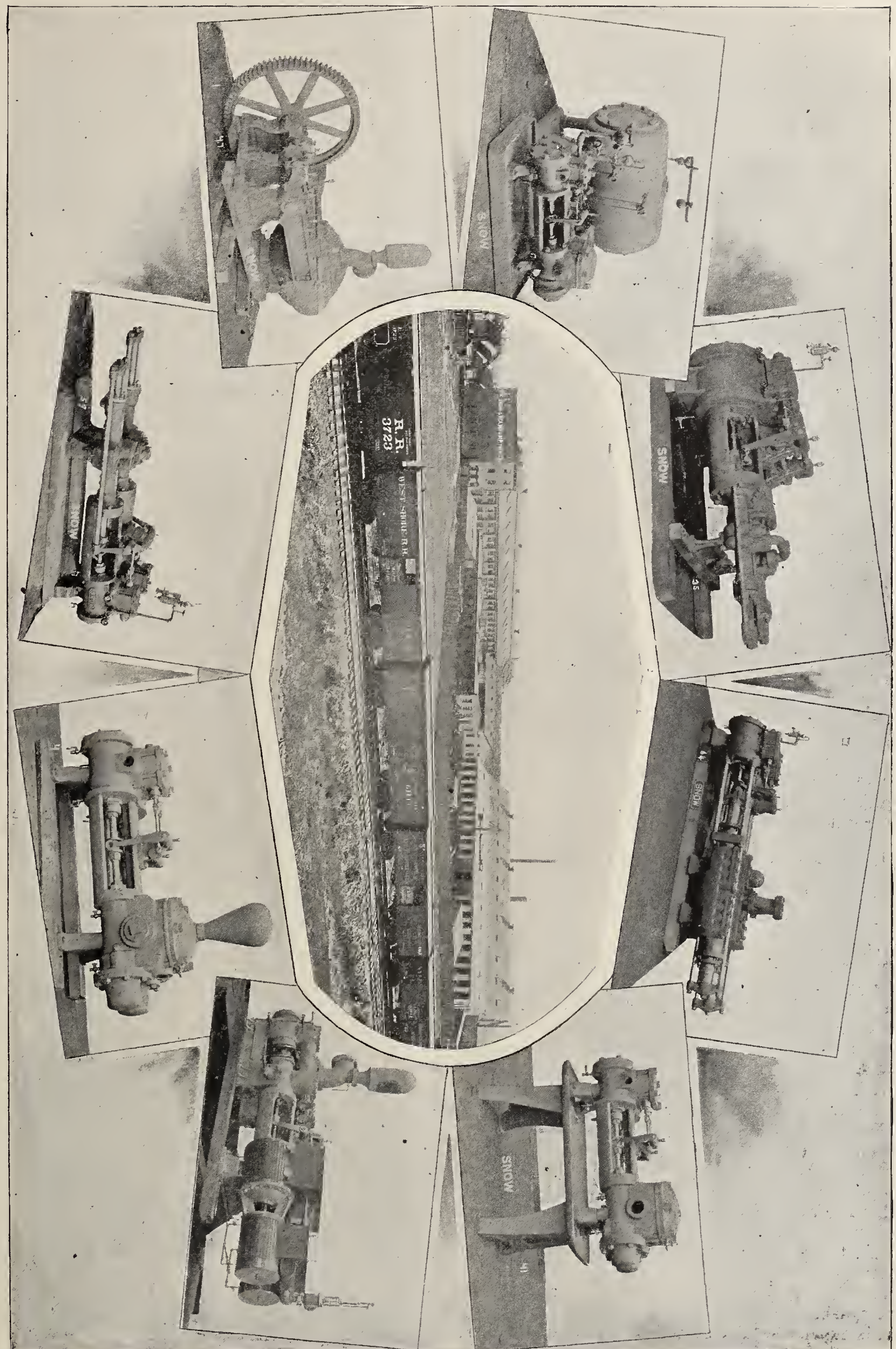
Tampa Bay, Fla., July 8, 1896.

To Elec. Age Pub. Co.:

Dear Sir:—Kindly answer the following question in your Inquiry Column: Can I put more than one closed globe arc lamp on a 110-volt. circuit, or do they differ from the low potential arc lamp without the globe? By giving me this information you will greatly oblige,

Yours truly, Thomas Lang.

(A.)—Only *one* closed globe arc lamp is placed on a



STYLES OF SNOW PUMPS.

110-volt circuit at a time, a resistance being in series with it. The low potential lamp takes 50 volts, the Manhattan at least 80 volts, thus preventing two in series from being burnt and requiring the use of a resistance.

(Concluded from page 454.)

end. But density of smoke and of crowded population in the adjoining lanes increased, and pleasantness, healthiness and convenience of the old college, both for students and professors, diminished year by year. If, my Lord Provost, your predecessors of the Town Council, and the citizens of Glasgow, and well-wishers all over the world, and the government, and the great railway company that has taken the old college, had not given us our new college, I do not believe that attractions elsewhere would have taken me away from the old college; but I do say that the 50 years of professorship which I have enjoyed would have been less bright and happy and I believe also less effective in respect to scientific work, than they have been with the great advantages with which the University of Glasgow has been endowed since its migration from the High street. My Lord Provost, I ask you to communicate to your colleagues of the Town Council, my warmest thanks for their great kindness to me in joining to celebrate this jubilee. Your Excellency, my lords and gentlemen, I thank you all for the kind manner in which you have received the toast of my health proposed by the Lord Provost, and for your presence this evening to express your good wishes for myself."—Science.

Turning from one extreme of temperature to the other, we have the investigations of Pictet in chemical action at temperatures ranging from –50° C. to –155° C. Under the influence of this extreme cold chemical action apparently ceases. For instance, 89 per cent. sulphuric acid, which freezes at –56° C., if cooled to –125° C., may be powdered and mixed with caustic soda of the same temperature without chemical effect. When this mixture is subjected to the spark of a Ruhmkorff coil, reaction slowly sets in and at –80° C. pervades the mass. With ammonia, sulphuric acid reacted at –80° C. to a limited degree, but at –60° the reaction was complete and there was a sudden rise in temperature. With sodium chloride the acid gave no reaction at –50° C., at 25° C. there was limited reaction, and above this the reaction was complete. The following are the author's conclusions:

1. At temperatures between –155° C. and –125° C. no chemical action is perceptible, whatever the nature of the substances employed.

2. Delicate tests, such as those with acids upon litmus paper, can be successfully applied at lower temperatures than may consist with very energetic reactions of other kinds, *e. g.*, that between sodium and sulphuric acid.

3. Every chemical action, according to the temperature at which it takes place, appears under one of two forms: (a) Slow action, which follows when the temperature is kept beneath a certain limit, varying with the substances employed, this kind of action being brought about either by an electric spark or spontaneously, depending upon the difference between the actual temperature and the above limit; (b) complete action, in which the heat generated by chemical union is communicated to the neighboring parts of the compound, until these are equally involved. In order to maintain slow action it is necessary in most cases that this heat be carried off by radiation; otherwise the temperature will very soon rise to that of complete action.

4. The best excitant of slow action is apparently the electric spark.

5. It is experimentally established that every chemical action commences with a period of negative energy, *i. e.*, a period in which external activity must be furnished to the component bodies, in order to allow of their combining.—*Cassier's Magazine.*

HISTORY OF THE X-RAY.

When a current is produced in a vacuum three phenomena are manifested—heat, fluorescence in the glass, and radiant energy; this is detected by a photographic film, some of the rays being cut off, and shadows shown on the film. This describes in a general way the Roentgen experiment.

Faraday found that if a current were produced in a vacuum tube having the positive and negative terminals of the circuit fastened one to each end of the tube, a luminous discharge took place. He also found that the rays coming from the positive terminal (anode) stopped before they reached the rays coming from the negative terminal (cathode), leaving a space known as Faraday's dark space.

This discovery, made in 1828, was followed in 1850 by the construction by Hittorf and Geissler, of Bonn, of the famous Geissler tubes, in which the luminescence was produced in a striated form. It was then found that by diminishing the electric pressure until the luminous effect had almost disappeared, the fluorescence on that part of the tube opposite to the cathode rays was greatly increased. Spittiswoode and Crookes continued their experiments along these lines, Crookes manufacturing his "Crookes' tubes." Then followed the discovery by Goldstein that the cathode rays were affected by a magnet.

In 1891 Hertz found that if a substance were exposed to cathode rays it cast a shadow. Metals were found to have the property of allowing the cathode rays to go through them, particularly aluminum. In 1893 Dr. Paul Lenard found that cathode rays could be made to pass into air. The final discovery was then made by Roentgen of a ray that was not affected by the magnet and which would go through metals.—Dr. Pupin.

WATER PRESSURE.

A crushed mass of iron now lying in a scrap yard at Pittsburg demonstrates the tremendous pressure of water at a great depth. It was constructed for a diving bell, and was intended for use in Lake Michigan. As originally constructed it was a cube about six feet square, tapering slightly at both ends. The material was phosphor-bronze, five-eighths of an inch thick. Each plate was cast with a flange, and they were bolted together, the bolts being placed as closely together as was consistent with strength. The side plates were further strengthened by ribs an inch thick and two inches wide, and the entire structure was strongly braced. The windows, intended to be used as outlooks by the divers inside, were three inches square, fortified with iron bars and set with glass plates one inch thick. The entire weight of the bell was 23,000 pounds. When completed it was sent to Milwaukee and towed out into the lake about 12 miles, where there was over 200 feet of water, and was sent down for a test. The manufacturer of the bell was so confident of its strength that he wanted to go down in it on the test trip. It was well he did not. When it reached a depth of about 100 feet, strong timbers which had been attached to it came to the surface in a splintered condition. Suspecting an accident, the bell was hauled up and found to be crushed into a shapeless mass. The inch-thick plate glass bullseyes were pulverized and the entire body of the bell forced inward until none of its original outlines remained. On a basis of 200 feet depth, the pressure that crushed this seemingly invulnerable structure was 86.8 pounds per square inch, or 353,924 pounds to each side of six feet square. The total pressure, therefore, on the cube was 2,723,548 pounds, or 1,361.7 tons.—Indianapolis Journal.

Phillipsburg, Pa.—The Phillipsburg Electric Lighting, Heating and Power Co. has been organized. Capital, $25,000. A charter has been secured.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 442.)

BZ EDWARD L NICKOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

In getting the variations of candles, a special device was required to keep the top of the burning candle at constant height in front of the bolometer strip. A suggestion of Mr. C. H. Bierbaum, M. E., resulted in the construction of the following simple and effective arrangement. A spiral spring, about 60 cm. long and 4 cm. in diameter, was attached to a small scale-pan, and the spring was cut off to such a length that when a candle was put on the scale-pan, the elongation was just equal to the length of the candle. The spring would then take up as fast as the top of the candle was lowered by burning. A small piece of sheet metal served to protect the spring from the heat of the candle. In order to keep the scale-pan from swinging sidewise, and from oscillating up and down, a couple of wires were passed vertically through holes on opposite sides of it, and served as loosely fitting guides, which, without interfering with the take-up of the spring, effectually damped any vibrations. The adjustment of a spring to any candle could be made in a few minutes with sufficient accuracy so that the height of the top of a candle burning on the scale-pan would not vary over one mm. in an hour. C, Fig. 2, shows this arrangement in place.

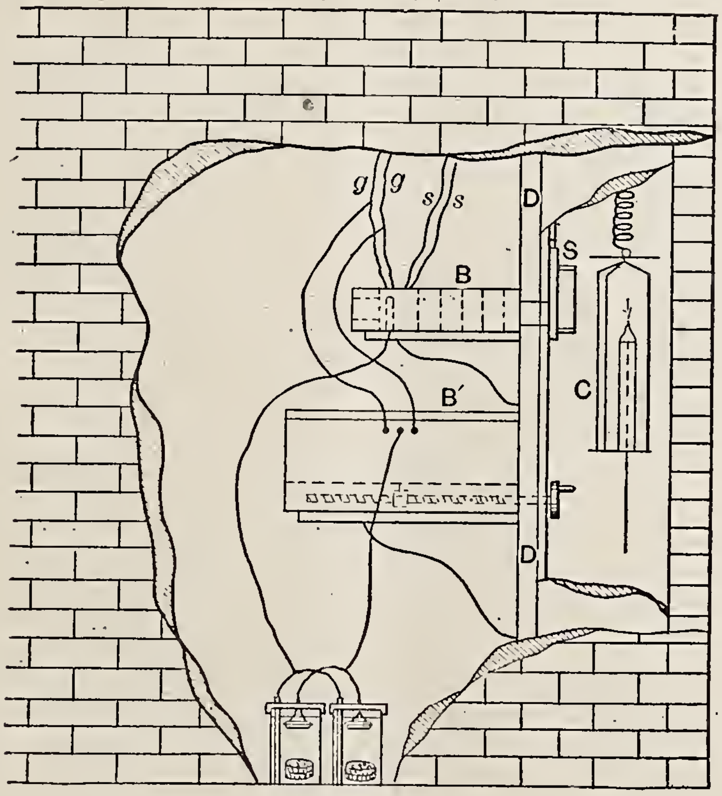


Fig. 2.

Method of Taking Observations.

All determinations of the variations of standards were made at times when the laboratory and its surroundings were very quiet. Most of them were made between the hours of 7 and 12 in the evening; a few were made on holidays, when the laboratory was closed for general work. Before beginning a set of observations the sensitiveness was adjusted, and the galvanometer was carefully watched for a considerable time to get the amount of

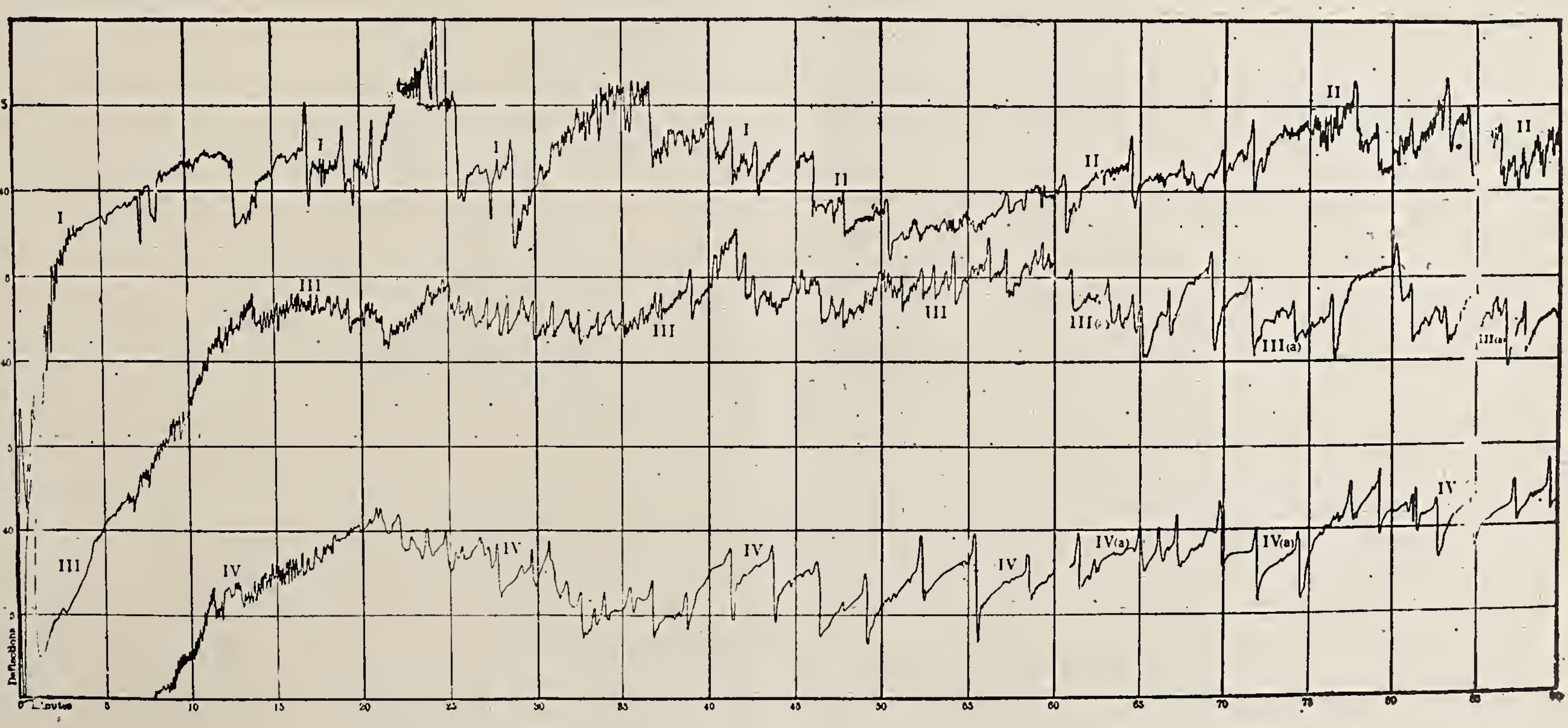


Fig. 3.

its swings due to currents of air about the bolometer strips or to changes in the earth's field. The sensitiveness was also tested from time to time. If the movement amounted to more than two-tenths of a scale division no run was attempted.

After taking these preliminary observations which usually required about an hour's time, the bolometer was exposed to the source of light. The galvanometer deflections were read rapidly by one person and were plotted by another as fast as read, the times being taken from a watch. In this way curves were traced which represent very truly all the changes in the radiation of the light source.

The character of the results obtained with the British candle is exhibited in Fig. 3.

An unfortunate feature in these curves is that the scale of abscissas, representing times, is so small. As a result of this, it has been difficult to represent with the greatest accuracy the true slope of those portions of the curves which correspond to very rapid changes in radiation. In examining the curve,it should be borne in mind that a very steep line may cover several seconds of time, and that it is quite possible that a photometric setting might be made during the time that a candle is executing just such a variation as is represented by the steepest parts of one of the candle curves. The number of galvanometer readings plotted during the space of five minutes was usually from 50 to 100.

At the end of a run, the strips and surrounding parts were given time completely to lose the heat imparted to them, after which readings for zero and sensitiveness were taken. The curves were corrected for changes in zero and in sensitiveness, using the equation:

$$\frac{\text{change in sensitiveness}}{\text{initial sensitiveness}} \times \text{approximate mean ordinate}$$

equals correction to ordinate.

It has been impossible to draw the curves so as to show clearly the minor fluctuations due to minute changes in the intensity of the radiation,since, as has been said, the scale to which the time abscissas are plotted is very small, compared with the scale of ordinates. These important peculiarities of the movements of the galvanometer needle were clearly perceptible, however, to one who observed the galvanometer deflections for only a little time, while their character made it perfectly evident that the swings of the galvanometer needles in their natural period exercised only an inappreciable influence on the slopes of the curves and the magnitudes of the variations recorded.

In Fig. 3, and in subsequent cuts containing bolometric curves, the smallest divisions of abscissas represent five minutes of time. The corresponding divisions of ordinates are five divisions of the galvanometer scale. In order to economize space, no attention has been given to the height of the curves relative to the base line on the plates. The total ordinates for each curve are indicated by such a symbol as this 40, indicating that the true X-axis for curves I. and II. should be placed ten divisions below the base line on the plate. Consequently, on the various plates, curves having the same ordinates are plotted one above the other, the true ordinate being indicated in the way mentioned above.

The data by which the curves have been corrected are given in Table I.

Table II. gives, in its first column, the approximate abscissas of the portion of the curve in question, and in its second column the mean ordinates of these portions. The third column contains the deviations of the mean ordinates of the portions from the mean ordinate of the whole curve. The fourth column contains these deviations reduced to percentages of the whole. The fifth contains similar deviations from the mean ordinate of all the curves of the particular standard under consideration, and in the sixth these also are reduced to percentages.

(To be Continued.)

NEW CABLE DEVELOPMENT.

Sir John Pender, whose death occurred in England last week, was "the father of the Atlantic cable," so far as the Old World was concerned. He worked in co-operation with Cyrus W. Field, and these two men were the originators of the present submarine service. But Sir John also became the head of a gigantic cable "combine." The London correspondent of the New York "Evening Post," in a dispatch to that paper on Saturday said:

"Sir John, with Scotch shrewdness, built up a huge cable monopoly in India, Australia, South, East and West Africa and the West Indies. Sometimes marriage alliances helped him, sometimes political influence, sometimes courtesies which fill Madeira and other salubrious cable stations with sprigs of English nobility. Heavy pressure from Canada and Australia, with Mr. Chamberlain's sympathy, is loosening this cable ring's tight grip upon the empire. A Pacific cable conference is now sitting in private at the Colonial Office, Earl Selborne, the Under Secretary, presiding. It has agreed that an all-British cable shall be laid forthwith from Vancouver, British Columbia, to Australia, via the Fanning Islands, Honolulu being tapped by a branch line. The conference now only has to arrange minor details. It has decided that the cable shall be laid and shall be managed not by a subsidized private company, but by a cable trust formed by the British, Canadian and Australian governments, raising a capital of £1,800,000 on joint guarantee. This new link with Australia proving a strategic and commercial success, extensions will be made to South Africa and India, thus creating a trunk line of imperial cables."

Now that Sir John has passed away his big monopoly is likely to be broken up. But the statement that the British government is contemplating the creation of a great system which shall include a practical monopoly of the Pacific is of special interest in this country, where for some time a project to construct a cable to Hawaii, and thence to Japan, has been under consideration. It will be a matter of regret if the British government gets ahead of us, for control of ocean cables means a great advantage, commercial and otherwise, in the up-to-date world.—Troy (N. Y.) Times.

Yesterday, H. S. Sands contracted with Stone & Thomas, for a complete electric lighting plant for their new building on Main street. The dynamo will be driven by two 30-horse-power gas engines. There will be 41 arc lamps and 200 incandescent and 128 show-case lamps. The outfit costs $5,700.—Wheeling, W. Va., "Intelligencer."

COST OF STREET LIGHTING.

In Brussels, M. Roully finds that, for street lighting, butterfly-flame burners, consuming seven cubic feet, give a light of 16 to 17 candles at a yearly cost of $11 each, while Welsbachs give a light of from 25 to 30 candles at a yearly cost, inclusive, of $11.26.—American Manufacturer.

COST OF GAS POWER ON STREET RAILWAYS.

Three eminent German engineers, in discussing a recently proposed plan for operating a street railway with gas, estimate the cost of a surface street railway equipped for electricity at $36,176 per mile, whereas a road equipped for gas operation would cost but $28,560 per mile—as a matter of fact, the cost of the gas road at Dessau was only $27,798.40 per mile. A 10-horse-power gas tramway car uses about 32 cubic feet of gas per car mile.—American Manufacturer.

Worcester, Mass.—The contract for the two elevators for the new City Hall was awarded to the Electric Co. of Springfield.

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CONTENTS.

	PAGE
EDITORIALS	
Business Competition	459
Motors	459
GENERAL SUBJECTS	
Lord Kelvin	454
History of the X-Ray	456
Water Pressure	456
Standards of Light	457
New Cable Development	458
Cost of Street Lighting	458
Cost of Gas Power on Street Railways	458
The Shinkage of Iron	459
Alternating Currents	460
Compressed Air Motors in France	466
TRADE NOTES	
Snow Steam Pump Co	453
La Burt Electric Railway	462
Otis Electric Elevators	463
Possible Contracts	466
Telephone Notes	467
New York Notes	468
NEW CORPORATIONS	467
New Telephone Companies	467
PATENTS	468
Telephone Patents	468
INQUIRY COLUMN	454

BUSINESS COMPETITION.

It has been frequently said that competition is the spirit of business. If this can be looked upon as the actuating force which impels not only the business man to sell, but the manufacturer to produce, then we are indeed unfortunate. There is no competition. None that would justify us in using the expression and which would give us the same pictured scene of bustling activity, such as we accustom ourselves to in periods of prosperity, such as we consider with regret in days of misfortune and financial stringency. They say that business itself is built upon a bubble. A mere inflated and unsubstantial something called confidence, which wavers like the shrinking candle light in a summer breeze. Yet, though this be true, and the substructure be intangible and unreliable, has such frightful upheavals been so frequent or so prolonged in the life of other nations?

Do they base their business on confidence, and therefore lose all aspirations when it is no longer there? There are many strong swimmers who enter a race without knowing that they will win. Upon what do they depend? Merely upon the fact that every fibre will be strained to win it; every ounce of blood used to its best.

In some, therefore, disappointment has no terrors and competition is truly the inward spirit that moves them to mighty deeds. We may well say that this great financial storm lashing the shores of America has been stirred up by a Western cyclone. There are many trying to reach a quiet harbor, but contrary winds have blown them hither and thither and the rocky snarls of the sea are lined with wrecks.

MOTORS.

The men that manufacture motors have frequently complained of the difficulty they have in getting people to buy. It seems to us that this is very discouraging. When a good article lies neglected because none will use it, the conclusions to be drawn are as follows: The party may not need it; they may not have enough money to buy it; they might be too conservative to touch it. Either of these are within the list of reasons worthy of consideration.

From many standpoints stationary motors are luxuries. Power is produced in large cities at a moderate expense and sold at a profit. In small towns, where water-power is abundant, it can be had cheaply. The use of a motor is then not a great item of expense. But it cannot hold its own with certain kinds of steam power. For special work it is the best means of supplying power; for general purposes the mere mention of the price means a period of deep silence and absolute refusal. No motor agents would complain if power was cheaper. All that is possible in the line of convenience lies in the use of a motor, and it would be used to an extent beyond our greatest expectations if some of our illuminating and power companies had paid a little more on their buried copper and new buildings. When the public desires a thing, factories can't turn that thing out quickly enough. It is difficult to bring them to this state of mind until they feel assured that they really need it. There are thousands of ice-cream freezers still to be turned by electric motors, and many more pumps in flats and apartment houses that are a source of constant worry to the self-sacrificing janitor.

In time this city will reek with motors, but that day of joy has not as yet approached. We are dependent upon others as yet, and the Jacques Battery has not depreciated the stock of any of the large lighting corporations, or dropped the price of an ampere hour. We are patient, as well as the honored representatives of motor firms.

THE SHRINKAGE OF IRON.

The action of fluid cast iron in the mould is somewhat curious. When poured into a mould in a state of fluidity, cast iron, and especially what is known technically as "gray forge," expands at the moment of solidification, thus giving a sharp impression in the mould. The expansion, slight but very noticeable, extends until in the process of cooling the iron attains the stage of red heat. Contraction then takes place, with the result that the cooled iron is noticeably smaller than the mould. In making patterns for iron castings, therefore, patternmakers commonly allow about one-eighth of an inch per foot for shrinkage. The shrinkage in castings, however, is by no means a constant quality, but varies materially with the proportion existent in the pattern and the character of the metal used—as much as one-tenth of an inch per foot being allowed when casting beams and only one thirty-second of an inch with large cylinders.

When any metal in a fluid state is poured into a cold mould, solidification commences at the outside. As the cooling is continued, the castings, therefore, would consist of a rigid outside envelope containing a soft interior. If, therefore, the condition of a small piece of such metal in the centre of a square be considered during cooling, it will be seen that the contracting force existing on each side of the square will be the same. A cube or sphere of cast iron contracts in cooling in a uniform manner throughout its mass. If two squares be placed side by side, forming a rectangle, on each half of the sides, the contracting forces are as before;

but on the ends, there being no rigid division between the two squares, both parts exert a unit of contracting force. The result is that the contracting force of the ends is equal to that of the sides; or, on a unit of length, the contracting forces are doubly as great on the ends as on the sides.

In casting, therefore, thin strips, the shrinkage of the length is very great, while in the thickness it is scarcely appreciable. A square plate shrinks little in thickness, but equally in width and breadth; a flat disk shrinks little in thickness, but equally in all diameters. A thin ring shrinks more in diameter than a thick one, and so on. When it is known that iron with different shrinkage from that generally employed is to be used in a foundry, the patterns are altered to meet the changed conditions. Silicon, unless in excessive quantities, gives a gray, soft iron which has the minimum shrinkage. In many cases a judicious mixture of iron will give the desired result without extra expense in pattern making. Charcoal iron has usually a higher melting point than that of less pure iron made with coke. It sets more quickly in the mould and contracts more, so that an extra allowance for shrinkage must be made in all patterns employed. It will be seen from the above that pattern makers require special technical skill as well as knowledge of the iron to be used in casting for their patterns. There are few employments which require greater specialized knowledge of rather a wide range than that of pattern making.—Industrial World.

ALTERNATING CURRENTS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

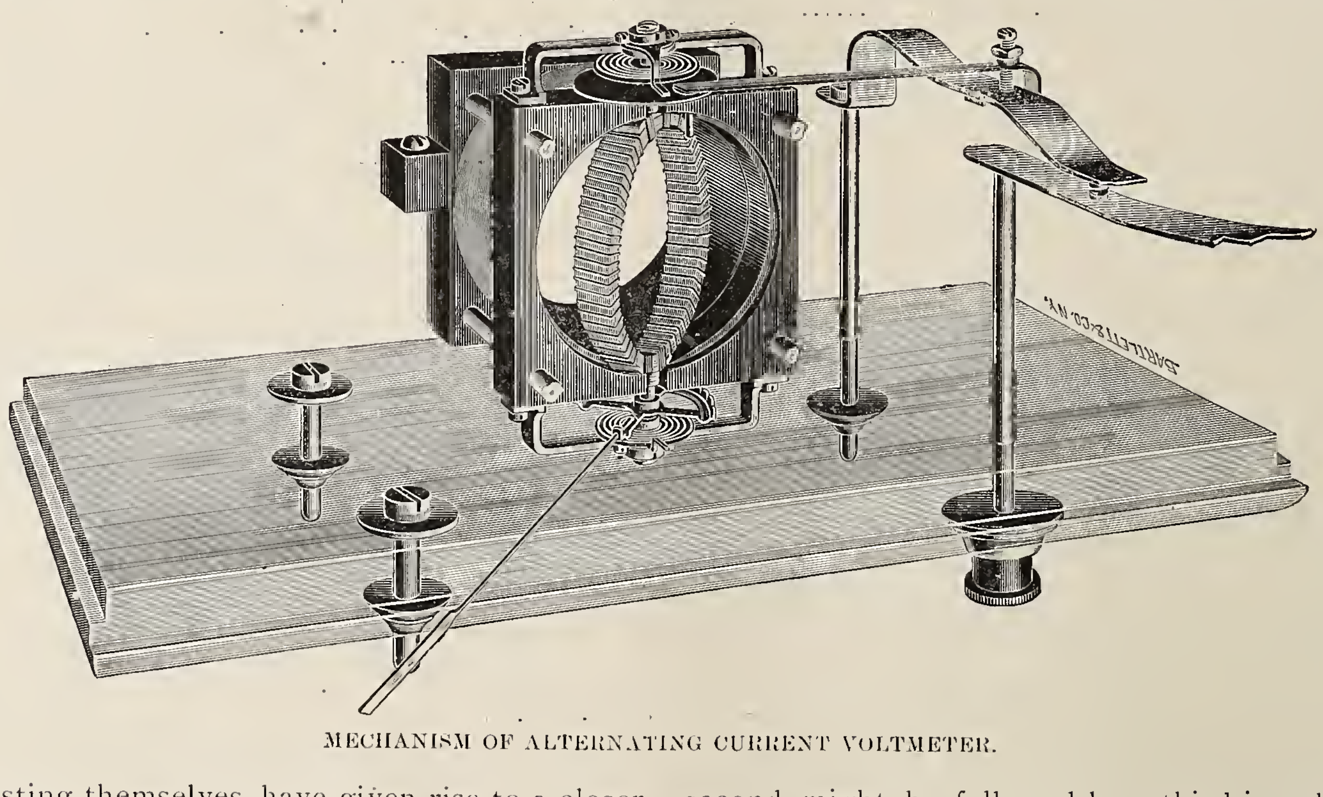
The interesting methods by which alternating current apparatus is designed and constructed, and the peculiar effects manifesting themselves, have given rise to a closer study of the subject in all its varied details. Not only have some of the greater difficulties been overcome, but its introduction beside and as an active and equal competitor of continuous currents in a commercial and practical sense is plainly evident.

Alternating Current Motors.—For many years the sluggish progress of alternating-current practice could be easily traced to the lack of a motor which could compete in the open market with the others. It had been deemed impossible to construct one of this kind. To obtain power in the form of mechanical energy from an alternating-current circuit necessitated the use of another alternator of the same frequency. This motor, to be, was rotated up to its proper speed by some additional device, and then the current applied.

Synchronism.—With the frequency or periods of both generator and motor equal, the machines are said to be in "step," or in synchronism with each other. The difficulty now arises, however; with a dropping in speed of the motor, this condition of electrical harmony, as it were, ceases to exist. Both machines fall out of synchronism, and the motor, after a short interval, comes to rest. This difficulty was for a long time ineradicable. It was impossible to start an alternating-current motor from a condition of quietude, and likewise impossible to hold it in synchronism with considerable changes of load. Any continuous-current motor, at least, possessed this qualification of being *self-starting*; a great handicap, therefore, stood in the way of making an even test of both systems. A difficulty of this character deprived the exponents of alternating-current machinery of a most valuable feature. Transmission of power was not very practical, although the mere laying of a long line was and has been an easy achievement.

Rotary Field Motors.—It was discovered by our famous inventor, Nikola Tesla, that if by any possibility a magnetic field was caused to travel around an iron circuit, or in any way allowed to affect an armature core wound or bare—if the metal mass in the centre is free to rotate—this circulating field will drag it around to a high rate of speed. A rotary field is produced by means of polyphasal currents—peculiar impulses, identical with an ordinary alternating current, but consisting of not one, but two or three successive impulses forward and the reverse backward.

Polyphasal Currents differ in no respect from an ordinary alternating current. A single impulse rising and falling in a wire can, in imagination, be succeeded by another before the first has begun to decrease. Likewise, the second might be followed by a third impulse, which has the same difference of phase between it and the second as exists between the second and the first. This system can be developed to any extent. To create a rotary field, for instance, with a current of these impulses or waves, a ring of iron wound with three coils each one-third around, and receiving successively a wave of electromotive force, would naturally produce a magnetic field of this description. Whether iron or copper be placed in the centre, the field will drag it around. A *polyphasal* current means a current of many phases; the word *poly* meaning many. The additional fact that when an arma-

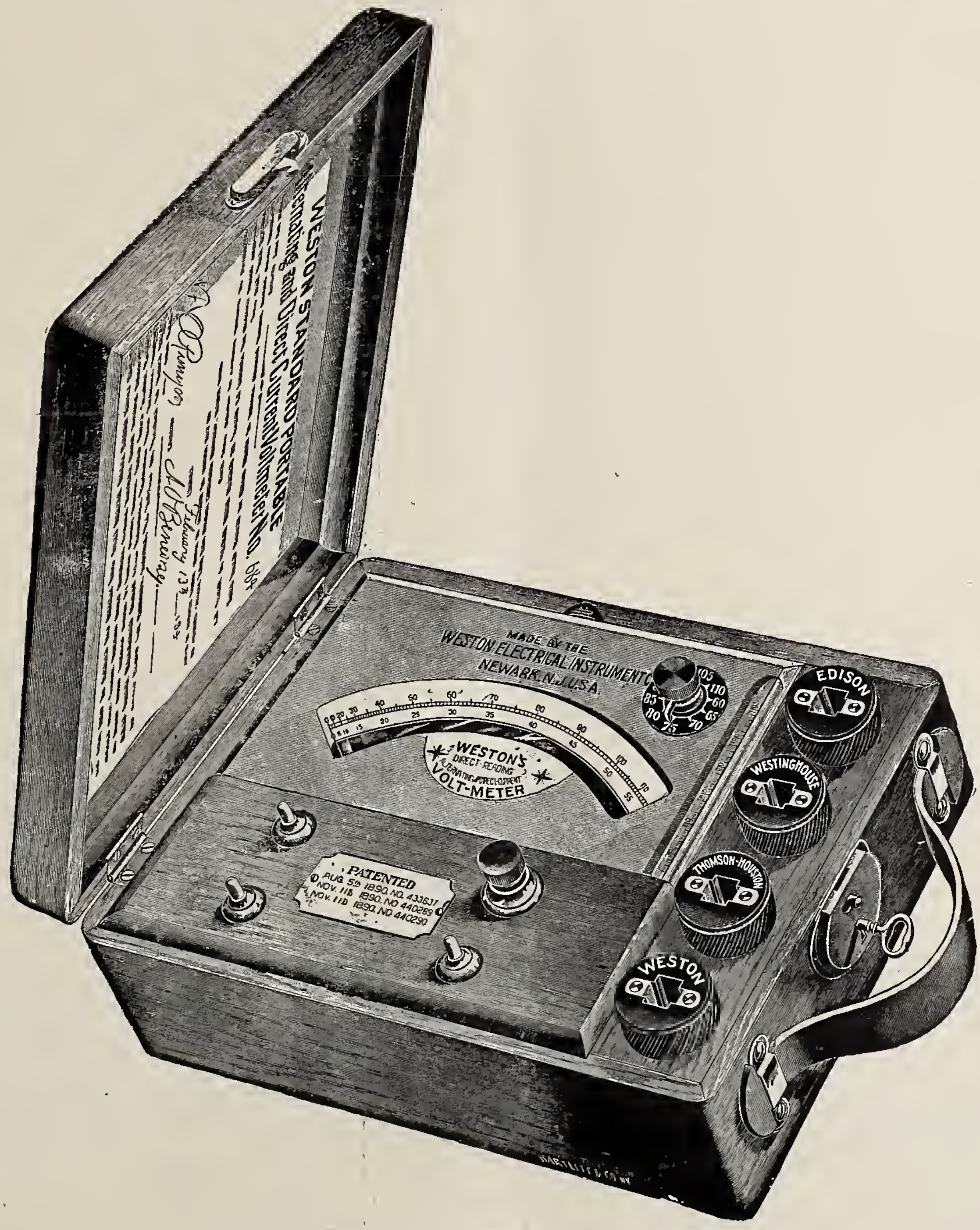


MECHANISM OF ALTERNATING CURRENT VOLTMETER.

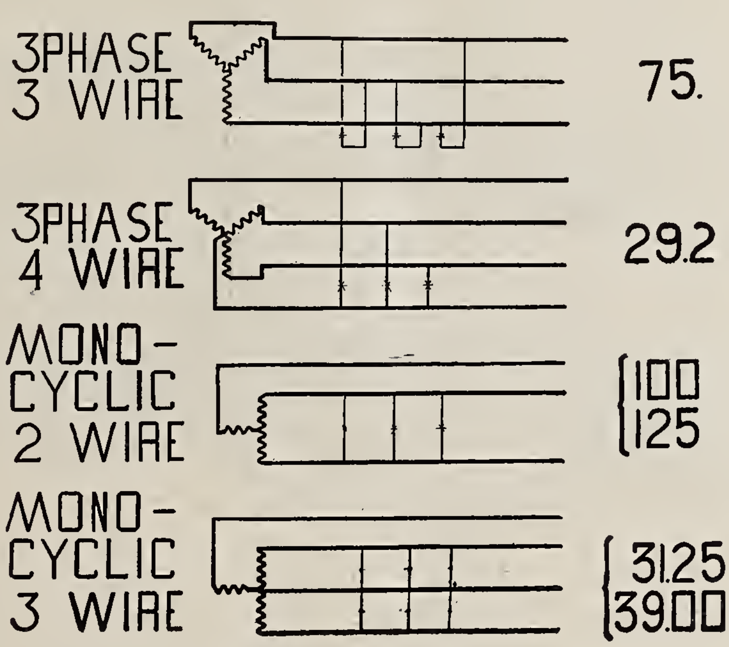
ture is gripped at points all around its periphery it is better able to develope torque, has made this innovation decidedly practical.

A Sine Wave is the name given to a wave of electromotive force or current proceeding from an alternator. It was discovered by Joubert that the mathematical curve called the sine curve and the diagrammatic representation of a rise and fall in electromotive force differed so slightly from each other that the latter deserved the same name.

True Value of the Current.—An alternating current has no fixed or uniform value. It rises and falls like an ocean swell, beginning, growing rapidly to a hilly prominence, and subsiding again to nothing. There is no definite value to be given to the flow of an alternating current that is other than approximate. At each instant of its growth and decrease it has a decided value, but this constantly changes, varying from nothing to a maximum; that is, its highest value. We are forced, therefore, to judge by approximation of its real strength; in fact, to measure it by two methods.



WESTON METER FOR ALTERNATING PRESSURES.



SYSTEMS OF ALTERNATING CURRENT DISTRIBUTION.

Mean Current.—One of these methods is that of taking the value of the current at successive instants of its rise and fall and forming an average, calling this the mean current. If the current rose and fell and the seven tests showed values of

0
2
4
6
4
2
0

the average would be $\frac{18}{7} = 2\frac{4}{7}$ amperes.

This value, 2.57 amperes, is called the *mean current.*

Square Root of the Mean Square.—Another method is that of taking the same measurements, squaring each result, taking the average of the squares, and then taking its square root. The process with the same figures would be that of squaring

$$\begin{aligned} 0 &= 0 \\ 2 &= 4 \\ 4 &= 16 \\ 6 &= 36 \\ 4 &= 16 \\ 2 &= 4 \\ 0 &= 0 \\ \hline & \;\; 76 \end{aligned}$$

Taking the average square,

$$\frac{76}{7} = 10\frac{6}{7},$$

extracting the square root gives us 3.29 amperes. In practice this value is accepted as the nearest approximation, and is used in ordinary calculations.

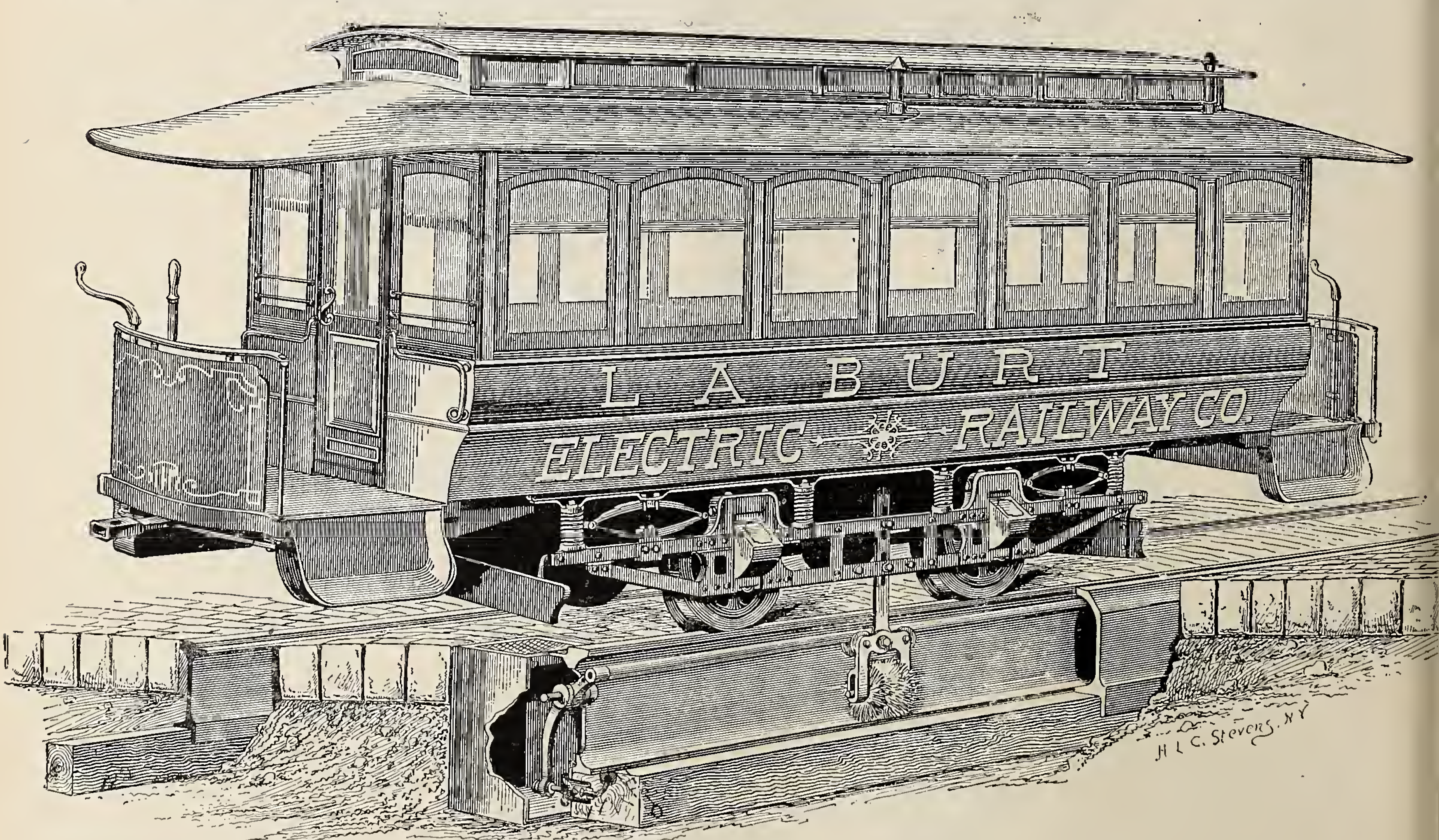
LA BURT ELECTRIC RAILWAY.

IN OFFERING the above illustrated system for propelling cars by electricity to the railway world, it has been the aim of the La Burt Electric Railway Company, of 39–41 Cortlandt street, to secure a system which would commend itself by reason of its simplicity, cheapness of construction, economy of operation, and reliance on well-known mechanical movements for its positive action, rather than upon electromagnetic features, which have proved so unreliable.

This system can be constructed at the same price as the overhead trolley for the same class of construction—that is, in cities, where pavement has to be taken up and relaid, it will cost the same, and in suburban districts where this expensive item is not encountered, it can be constructed as cheaply.

By this system any railroad, either steam, horse or trolley, can be turned into an underground electric road by putting the rail channel for the trolley between the tracks, while in new construction this item of expense can be done away with, as the rail channel can just as well be applied at the side of either rail. Less than one foot of excavation is needed.

The illustrations herewith plainly show that the live wire is laid in lead pipe underneath the stringer, or underneath the rail, where a joint is made and connection effected with the junction boxes, in which the contact is made. As the car comes along the trolley runs on the under side of a hollow steel tube, supported at either end by rock levers. As the tube is thus raised, the finger on the lower end of the rock lever is forced in, contact is made, and as the car passes on the tube drops by gravity, contact is broken, leaving the sections behind perfectly "dead." It will thus be seen that there is practically on



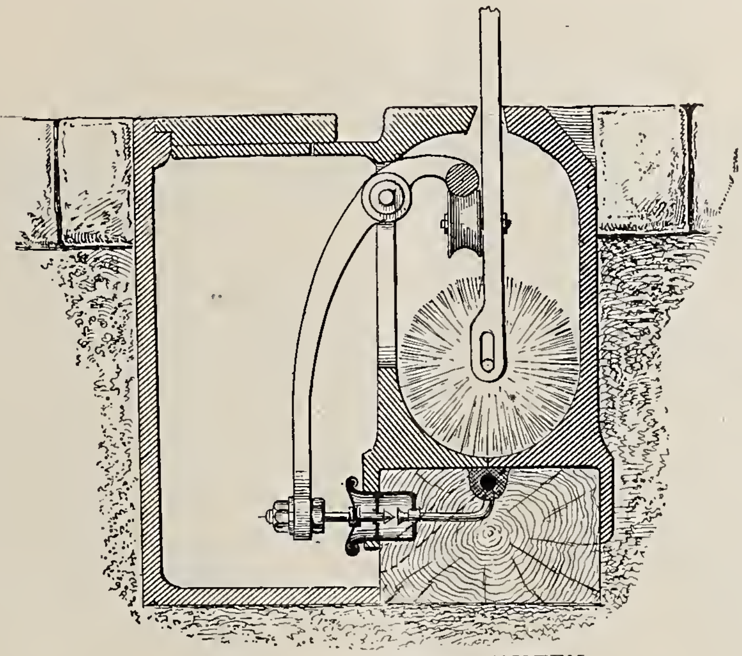
LA BURT ELECTRIC CAR.

London, Ont.—The Rogers Electric Company has been awarded the contract for wiring the new House of Refuge at Sarnia.

Guelph, Ont.—The contract for an electrical fire alarm system has been awarded to the Bell Telephone Company, of Montreal.

loss of current, as for every pound of coal consumed at the power station, the required number of units of energy are delivered direct to the motor under the car, because the current is only used while the car is over a given section, and that section is cut out and becomes perfectly "dead" as the car passes to another section. At no

time is there any current on either rail. The outside wall of the rail channel is formed by an extra piece of metal bolted and braced to the ties, while the inside wall is formed by the rail itself, either a six or a nine-inch rail being sufficient to form the channel, and all that is necessary for the successful working of the system.



CONDUIT OF LA BURT SYSTEM.

An electrician, or fairly intelligent citizen, knows that the overhead trolley is a menace to the life of every man as well as to his whole family, whose door it passes. The live trolley wire breaks, falls across the track whenever a high wind raises, or a storm of sleet coats them with snow or ice, a circuit is formed, the track is charged for blocks in either direction, and the unfortunate man or beast who steps thereon at such a time never knows what killed them. Or, the yet weaker telegraph or telephone wire breaks and falls across a live trolley wire in a storm, killing the unfortunate who runs against it. All this is utterly impossible with the La Burt system.

The future of the overhead trolley is limited, and it is possible and even probable that the next ten years will see the last of a system so crude, and so exposed to the rigors of the atmosphere and winter storms.

OTIS ELECTRIC ELEVATORS.

The Otis Company, of No. 38 Park row, New York, have met with the greatest success in all their engineering ventures. They have never disregarded the old and well-worn adage "Whatever is worth doing is worth doing well," and in every undertaking have exhibited a patience and skill which is the secret of their success. Their long and varied experience in the manufacture of hydraulic and steam elevators have enabled them to produce an electric elevator which in construction and operation has not been equalled by any other in the market. The first they ever installed has been in operation over five years. Over 1,000 electric elevators in this and foreign countries give and will continue to give the greatest satisfaction.

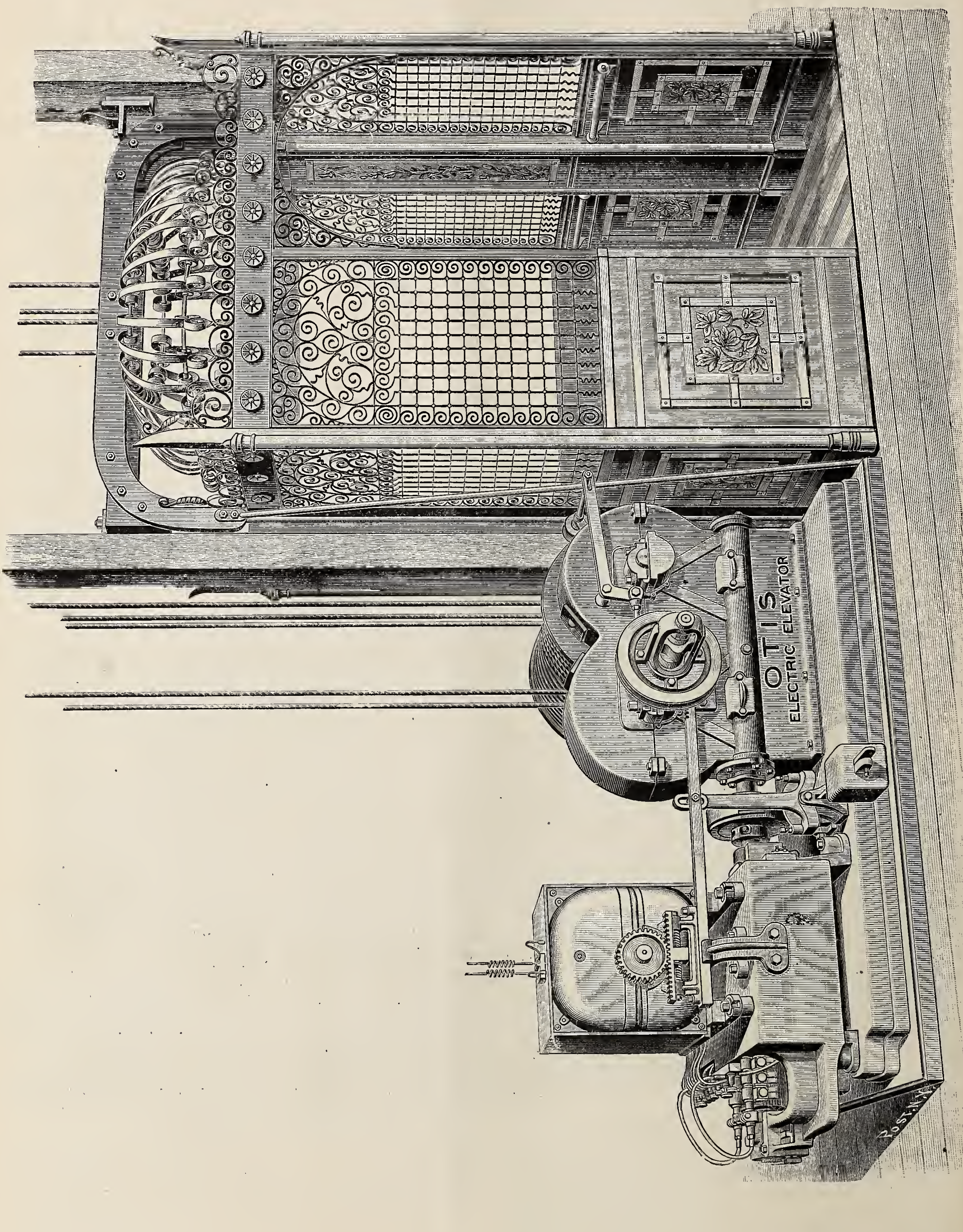
Many companies have come into existence on account of the success of Otis Bros. They are the first, however, in the electric elevator line, and have made their name a synonym of safety, durability, economy and simplicity.

The recent experiments of M. Henri Moissan with high temperatures are most interesting and his results well-nigh incredible. M. Moissan, however, needs no introduction, his work with the element Fluorin being well known and a sufficient guarantee of his exactness. It has been determined quite recently that, owing to imperfections in the pyrometers formerly used, the temperatures above 1000° C. have been grossly exaggerated. The highest temperature attainable by coal-gas and an oxygen blast is about 2000° C., while the highest temperature utilized in industrial work is only about 1500° C. At the former temperature a quicklime crucible only can be used. Hence it will be seen that the temperatures obtained by M. Moissan are most remarkable. For these higher temperatures a furnace is constructed of two bricks of quicklime, carefully cut out and placed one above the other, the lower brick having two longitudinal grooves for the electrodes and a small cavity in the middle to serve as a crucible. The arrangement is thus similar to that used in melting platinum. In the first experiments a small Edison dynamo driven by a gas-engine was used. A current of 30 amperes and 55 volts gave a temperature not much exceeding 2250° C. Later a current of 450 amperes at 70 volts was used, representing about 50 horse-power, and with this 3000° C. was attained.

At 2500° C. the oxides of calcium, strontium, and magnesium crystallized rapidly, and at 3000° C. the quicklime of which the furnace was composed ran like water. At this same temperature the lime was reduced by carbon, and the metal calcium was "liberated in abundance." A carbide of calcium was also obtained fusible at a red heat. Fine crystals of the borides and silicides were readily formed. Magnesia was melted as easily as the lime, and alumina was melted and crystallized at 2250° C. By the addition of a small amount of the oxide of chromium, artificial rubies were obtained. By continuing the treatment of alumina this was completely volatilized, thus providing a parallel case to the volatilization of silica, effected by Seger. Titanic acid was crystallized, fused, and volatilized according to the temperature, and zinc oxide was volatilized freely and deposited in long, transparent needles. M. Moissan, it is said, has also produced a number of microscopic diamonds by the crystallization of carbon after the following method: Pure carbon obtained by burning sugar was dissolved in an ingot of iron and this then heated to 3000° C. By the application of cold water a sudden crystallization was effected, and true diamonds of microscopic size were obtained. As M. Moissan is continuing his researches, further results will be looked for with interest.—*Dr. R. A. Witthaus, in Cassier's Magazine.*

Harrisburg, Pa.—A charter has been issued to the Pittsburgh and Clearfield Telephone and Telegraph Company, of Phillipsburg, to build and operate telephones in the counties of Centre, Clearfield, Cambria and Jefferson. Capital, $1,000. Directors: William H. Denlinger, John G. Platt, Andrew J. Graham, Thomas J. Lee, Griffith Lychenthaler, Phillipsburg.

Montreal, Que.—The Montreal Park and Island Railway has recently let the contract for the construction of the St. Vincent de Paul branch, to be completed this fall.


OTIS
ELECTRIC ELEVATOR

COMPRESSED AIR MOTORS IN FRANCE.

A line on the Popp-Conti system is to be opened in St. Quentin, France, in the Department of the Aisne,in which the inventors have sought to create an intermediary system which would obviate the two principal objections, the carrying of a large amount of dead weight and the loss of time in taking cars to the charging stations. To do this it was necessary to provide, on the line of rails over which the cars travel, a series of stopping-places at short intervals, corresponding to the stations where passengers enter and leave the vehicles. It was desirable that while this necessary stop was being made communication should be automatically made between the reservoirs on the car and the air mains placed beneath the track. As the pressure of air in the main, delivered from the central station, located at a point more or less removed, was comparatively low, and as it was necessary to retain in the reservoirs on the car a sufficient amount of compressed air to carry a car over two sections of the line in the event of one section being out of order, it was evident that the reservoirs must be relatively large and the charging stations close together. In the St. Quentin installation the central station is equipped with three 100-horse-power compressors. The central station under this system does not have to labor under the disadvantage of having to provide an irregular amount of power, or rather the irregularities occur at fixed intervals and within well-known limits. The distributing mains comprise pipes varying from 1.6 to 4 inches in diameter, and as the rails comprise a number of lines diverging from one common point, a few circular lines of air mains are found to supply the different air junctions desired, with a total length less than that of the tracks. By the use of the looped system of mains, it is possible to isolate any section of pipe for repairs, by means of valves, while the rest of the system is kept under pressure. At each station the rails and on the level of the roadway a jointed plate, which under certain conditions opens freely in the centre. The passage of the first pair of wheels over the rails causes the plate which covers a brick pit to open. From the pit rises a flattened pipe, which is in communication with the air main, and is joined to a pump barrel. The whole governing of the junction arrangements between the air main and the mouth of the receiver on the car is under control of an ingenious device intended to be operated only by the vehicle which it is intended to serve.

The first and second pairs of wheels operate, as stated, upon a pedal. This is placed in a section of special rail between two ordinary rails and immediately adjoining the plate. The pedal is operated by the flanges of the car wheels, and is so held up by means of a coiled spring as not to be operated except under a considerable weight. Thus the narrow wheels of a light vehicle may enter the grooves of the rail and pass over the pedal, which would remain unaffected by its relatively light pressure, while a heavy truck of weight approaching that of the street car will necessarily have a wheel too broad to enter the groove of the rail, and therefore could not touch the pedal. The second pair of wheels passing over the pedal reverse the operation, sever the air connection and return the junction mechanism to its place in the pit beneath the street level. There are a number of ingenious details attaching to the junction of the feed connection with the car-storage reservoirs. The charging of a car with the requisite energy is stated to occupy only fifteen seconds. The motor is placed under the middle of the car and is accessible from the interior. It is a compound engine with variable expansion, and according to the power required it can be worked with double expansion or by full admission of air into the cylinder. The Popp-Conti system comprehends the double heating of the compressed air before it is admitted into the cylinders. This is accomplished by means of a coke fire,which is fed automatically. The motor may be driven from either end of the car by means of three small valves placed conveniently for the driver. The first of these operates the links, the only function of which is to change the direction of the engine. The admission of air into the small cylinder is regulated by means of valve gear, which is controlled direct by the driver, and the same hand wheel which governs the full range of power of the engine also serves in its altered position to apply the maximum retarding power of the brakes.—American Gas Light Journal.

WHERE ARE WE?

The ratio of increase in the yearly consumption of gas is decreasing. It sounds a bit strange that an increase can decrease, but it is not at all strange to learn that the decrease of the increase is due to various mills having introduced the electric light. Long may there and elsewhere the decrease in the increase of the use of gas go on, and the increase in the increase of the use of the electric light continue. If the increase of the increase——.—London Electricity.

POSSIBLE CONTRACTS.

Pottsville, Pa.—The borough is considering the advisability of erecting its own electric light plant.

Xenia, O.—Sealed proposals will be received until 12, noon, Sept. 1, 1896, by the trustees of the Ohio Soldiers and Sailors Orphan's Home at Xenia, O., for the furnishing, construction and operation of an electric light plant, in accordance with the plans and specifications proposed therefor. Proposals must be addressed to David Lanning, superintendent, Xenia, O.

Philadelphia, Pa.—Sketches have been completed by Cope & Stewardson for a hospital for the Pennsylvania Institution for the Blind. The building will be two stories high and the latest systems of electric wiring, steam heating, etc., will be used. The entire cost is not to exceed $100,000.

Toledo, O.—Sealed proposals will be received up to 11 o'clock a. m., of Thursday, the 20th day of August, 1896, for the furnishing and installing of the electric light, fixtures for the new Lucas County, O., court-house, according to general plans and specifications prepared by David L. Stine, architect, which are on file at the office of the auditor of Lucas County, O. Bidders may also submit designs of their own, based upon the general specifications. Address Chas. H. Jones, County Auditor.

St. Paul, Minn.—The county commissioners have decided to invest in an electric light plant for the city hospital.

Berlin, Conn.—Electricity is to be used in the lighting of the new passenger station. Fifty-seven lamps will be put in.

Albany, N. Y.—Messrs. Lewis & Wallace, patentees of the Crown automatic car coupler, will probably locate their plant in this city.

New York City.—Plans have been prepared for a new addition to the St. John's Home for Boys, to cost about $250,000.

Norfolk, Va.—A syndicate of New York and Boston capitalists will erect an eight-story hotel, to cost about $750,000. Plans and specifications for the same have been prepared.

Washington, D. C.—Work will soon be started on the improvements of the House and Senate chambers of the Capitol. $55,000 are to be expended on the improvement of the ventilation of the Senate wing, including the installation of refrigerating apparatus, and $45,000 for an extension of the electric light plant at the Capitol. Contracts for the performance of these works are now being let.

New York City.—John Casey, of No. 115 West 91st street, will build three brick stores and flats, to cost $275,000, on the southwest corner of Amsterdam avenue and 105th street.

Wm. B. Frank, of No. 131 West 129th street, will build a stone, brick and terra cotta apartment house, to cost $150,000, at the northeast corner of West End avenue and 79th street.

Plans are being prepared by Bruce Price for a sixteen story terra cotta and brick office building to be erected on Broadway and 26th street; cost, $1,500,000.

A ten-story brick building will be erected at Nos. 570-572 West Broadway, by John B. Ireland, at a cost of $125,000.

Negaunee, Mich.—The common council has decided to look into the matter of electric lighting with a view to building a city plant, and is securing estimates from electrical engineering firms.

Carthage, O.—An election will be held August 8th to vote on the issuance of bonds to extend the water and light plants, and the construction of an electric fire alarm.

The Edison Electric Company, of New Orleans, La., will remove its plant and erect a new structure. It is stated that the proposed building will be of stone and steel, cost about $85,000, and will have engines of 6,000 horse power.

NEW CORPORATIONS.

Detroit, Mich.—The Commercial Supply Co., manufacturing electrical supplies, has been organized and incorporated with a stock of $1,500 paid in, by Perry E. Phillips and A. A. and Geo. L. Robinson.

Elizabeth, N. J.—The Imperial Electric Company, of Westfield, has filed articles of incorporation. The company will begin business with a stated capital of $60,000, and will manufacture electrical machines and supplies. The incorporators are J. W. Eskhorn and W. B. Elliott, of Westfield, and J. J. Linder, of Brooklyn.

Chicago, Ill.—Marquette Electrical Company, Chicago; capital stock, $2,500; incorporators, Edwin O. Lanphere, Henry J. Brubaker and Ripley N. Baylis.

Chicago, Ill.—Carbon Rheostat and Electrical Manufacturing Company, Chicago; capital stock, $10,000; incorporators, Sydney Stein, Henry R. Platt and Frank Crowe.

Joliet, Ill.—The Joliet Electric Street Railroad Company has been reincorporated, and the capital stock placed at $300,000. The officers are: Jacob A. Henry of Joliet, president; Geo. F. Duncan, Portland, Me., vice-president; Henry O. Cox, Portland, Me., treasurer; William B. McKinley, Chicago, secretary and manager.

NEW TELEPHONE COMPANIES.

Indianapolis, Ind.—Tippecanoe Telephone Company, of Romney, has been incorporated, with a capital of $10,000, to operate lines in Tippecanoe, Clinton and Boon counties.

Baltimore, Md.—The Standard Telephone Company, of Baltimore, has been incorporated by Thomas S. Hodson, Charles O. Cooper, Edward S. Kines, J. Tiers Reardon and Wm. F. Beiswanger. Capital stock, $15,000. J. Tiers Reardon is president, and C. O. Cooper, secretary. The treasurer has not been elected. To construct telephone lines from Crisfield and Pocomoke City, thence to Salisbury, Delmar, Laurel, Easton, Chestertown, Centreville, and Belair, with connections in Baltimore.

Wilkesbarre, Pa.—The People's Telephone Co. has been chartered to build a line from Hazleton through Wilkesbarre and Pittsburg. Capital stock, $5,000. Directors, M. B. Houpt, C. E. Stegmaier, A. A. Sterling, P. R. Raife and John A. Schmitt.

Springfield, Ill.—The Richland County Telephone Company has been incorporated at Olney, with a capital stock of $25,000. The incorporators are: Edwin E. Crebs, E. J. Briswalter and G. M. Brock.

Austin, Tex.—Cicero Telephone Company has been incorporated. Capital stock, $10,000. Incorporators, R. H. Trail, W. O. Cline, Louis Nissen, C. H. Zimmerman, O. J. Roath, George D. Rogers and M. I. Isgrig.

TELEPHONE NOTES.

Youngstown, O.—The Mahoning Valley Electric Railway Company, will during the next month establish a metallic return telephone system along the entire line. It will be one of the most notable improvements made since the line has been in operation. When the telephone service is established the Youngstown and Niles powerhouses can have telephone connection. Work on the system will be commenced in a short time.

Muskegon, Mich.—A 30-year franchise has been granted to the Citizens' Telephone Company to put in an exchange and supply 'phones for residences and business places. The officers of the company are: President, Peter C. Burns, of Kokomo, Ind.; Vice-President, Chas. H. Hackley; Treasurer, L. B. Smith; Secretary, Hugh Park. The exchange will be installed by Oct. 1 and a state line be in between Grand Rapids and Muskegon by Nov. 1.

Buffalo, N. Y.—W. R. Smallwood is putting a telephone line into the village of Cattaraugus similar to the one in Gowanda.

Maiden Rock, Wis.—W. E. G. Loeffler contemplates extending a telephone line from Stockholm to Lunel, so as to have communication with Pierce County towns, a distance of about seven miles.

Greenwich, N. Y.—A telephone line from Cossayuna to Fort Edward, a distance of 14 miles, will at once be constructed. John Huchens has the contract for the placing of the poles.

Batavia, N.Y.—The Automatic Service Telephone Company, of Buffalo, has filed an application for a franchise to do business in Batavia.

Atlanta, Ga.—The Atlanta Telephone Company secured a charter to operate a new telephone system in Atlanta. By the charter the company was required to commence actual work within 90 days from the time of granting the charter. Work has not been yet commenced, but the company was yesterday given an extension of time of 60 days longer.

Wayne, W. Va.—Cooper & Johnson, local contractors, have received the contract and right of way to construct a telephone line between East Lynn and Huntington, a distance of about 30 miles.

Norfolk, Va.—There is a move on foot to establish a telephone line from Smithfield to Norfolk, by way of Isle of Wight courthouse, Windsor and Suffolk, and to connect all the territory on Hampton Roads.

Chicago, Ill.—The Austin Business Men's Association has been granted a franchise by the town board of Cicero to place a local telephone exchange in the town. The new company has a capital stock of $10,000, and will also put in a burglar and fire alarm system.

Grand Rapids, Mich.—The Saugatuck and Ganges telephone line is to be extended to Allegan to connect with the state asylum.

Westerly, R. I.—The Providence Telephone Company is to make all its Westerly system over into the metallic circuit. This improvement is being made now, Mr. W. M. Gates being in charge of the work.

Laurel, Ia. The question of a new telephone connection with Gilman is now being agitated at Laurel.

Somerville, N. J.—The stockholders of the Somerville and Raritan Telephone Company, which has been in business a little over a year, have sold their stock and transferred their company, with its property and business, to the New York and New Jersey Telephone Company.

New York Notes.

Mr. O. B. Green, the incandescent arc lamp supply man, of No. 14 Cortlandt street, New York, was at Chautauqua Lake with a special X-ray outfit, designed by Max Osterberg, E. E. A. M.

The Westinghouse Electric and Manufacturing Company has received an order from the Carnegie Steel Company, Limited, for a complete electrical equipment for the Duquesne Steel Works. The new equipment will furnish power for all light cranes, and it is expected that electricity will be employed also in driving the rolls. There will be sixteen large dynamos at the start, and the installation will be made with a view to adding other dynamos.

Gillett, Col.—Gillett recently celebrated the starting of the electric light plant, the starting off being without a jar. The plant, although small, is one of the best in the State, and is owned by Denver parties. It consists of Thomson-Houston generators and General Electric fittings. The engine is of the new patent ball-governing kind, being the first to be used in Colorado.

Judgments by confession were entered yesterday in the Circuit Court against the National School of Electricity for $5,626 and $469, the first amount in favor of John J. Swenie and the other in favor of Louise C. Stanton. The offices of the concern at No. 335 Dearborn street, were closed by Deputy-Sheriff McMahon, on executions issued upon the judgments.—Chicago Tribune, May 30.

Albany, N. Y.—The Washington County Telegraph and Telephone Company has been incorporated to construct and maintain a telephone or telegraph line. Capital, $3,500; and directors, J. Somes McClellan, of Cambridge, W. L. Dundon, of Salem; D. L. Hall and N. S. Pratt, of Cossayuna; W. D. Stevenson, of North Argyle; R. Van Wormer, of Argyle, and W. C. Cuthbert, of Fort Edward.

TELEPHONE PATENTS.

ISSUED JULY 15, 1896.

563,877. Telephone System. W. R. Patterson, Chicago, Ill. Filed Jan. 21, 1896.
563,920. Telephone System. A. Graham, London, England. Filed May 3, 1894.
563,935. Telephone Transmitter. H. A. Martin, Hartford, Conn. Filed Nov. 13, 1895.
564,173. Telephone Exchange Apparatus. J. J. Carty, New York, N. Y. Filed Nov. 17, 1887.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued July 14, 1896.

563,724. Annunciator System for Buildings. J. M. Arthur, Detroit, Mich. Filed April 1, 1896.
563,743. Circuit Controlling Device. J. H. Clark,, Boston, Mass. Filed Jan. 29, 1892.
563,749. Trolley Wheel. C. W. Cottrell, Asbury Park, N. J. Filed Aug. 28, 1895.
563,773. Electric Arc Lamp. J. C. Knight, Roselle, N.J. Filed Nov. 21, 1895.
563,780. Electric Heater. C. H. Minchew, Taunton, Mass. Filed Nov. 19, 1895.
563,831. Thermostat. L. G. Woolley, Grand Rapids, Mich. Filed June 24, 1895.
563,832. Automatic Fire Alarm System. J. Young, Chicago, Ill. Filed Aug. 8, 1895.
563,895. Rotary Transformer. E. Thompson, Swampscott, Mass. Filed Dec. 21, 1893.
563,911. Dynamo-Electric Machine. W. Cooper, Schenectady, N. Y. Filed April 18, 1896.
563,917. Instrument for Measuring Electric Resistances. S. Evershed, London, Eng. Filed Feb. 6. 1896..
563,922. Electric Lamp Stand. W. D. Gridley, Brooklyn, N. Y. Filed Feb. 19, 1896.
563,924. Railway Signal. C. Hansel, Easton, Pa. Filed Dec. 4, 1895.
563,940. Dynamo-Electric Machine. A.L. Parcelle, Boston, Mass. Filed Jan. 7, 1896.
563,960. Electric Light for Cold-Storage Rooms. D. B. and R. H. Hawes, Springfield, Mass. Filed May 22, 1896.
563,998. Trolley Finder. H. H. Blanchard, Augusta, Me. Filed Sept. 24, 1894.
564,036. Electric Headlight for Street Cars. A. C. Thompson, St. Louis, Mo. Filed Aug. 26, 1895.
564,054. Electric Railway System. D. M. De Witt, Morrillton, and W. K. Elliott, Little Rock, Ark. Filed Jan. 29, 1896.
564,084. Protective Appliance for Electrical Apparatus. A. De Khotinsky, Boston, Mass. Filed May 5, 1896.
564,101. Printing Telegraph. J. J. Reifgraber, St. Louis, Mo. Filed July 30, 1895.
564,168. Speed and Direction Indicator. G. A. Tower, Richmond, Va. Filed March 21, 1896.
564,174. Armored Insulating Conduit. R. T. Elwell, Hyde Park, Mass. Filed Jan. 28, 1896.

The Electrical Age.

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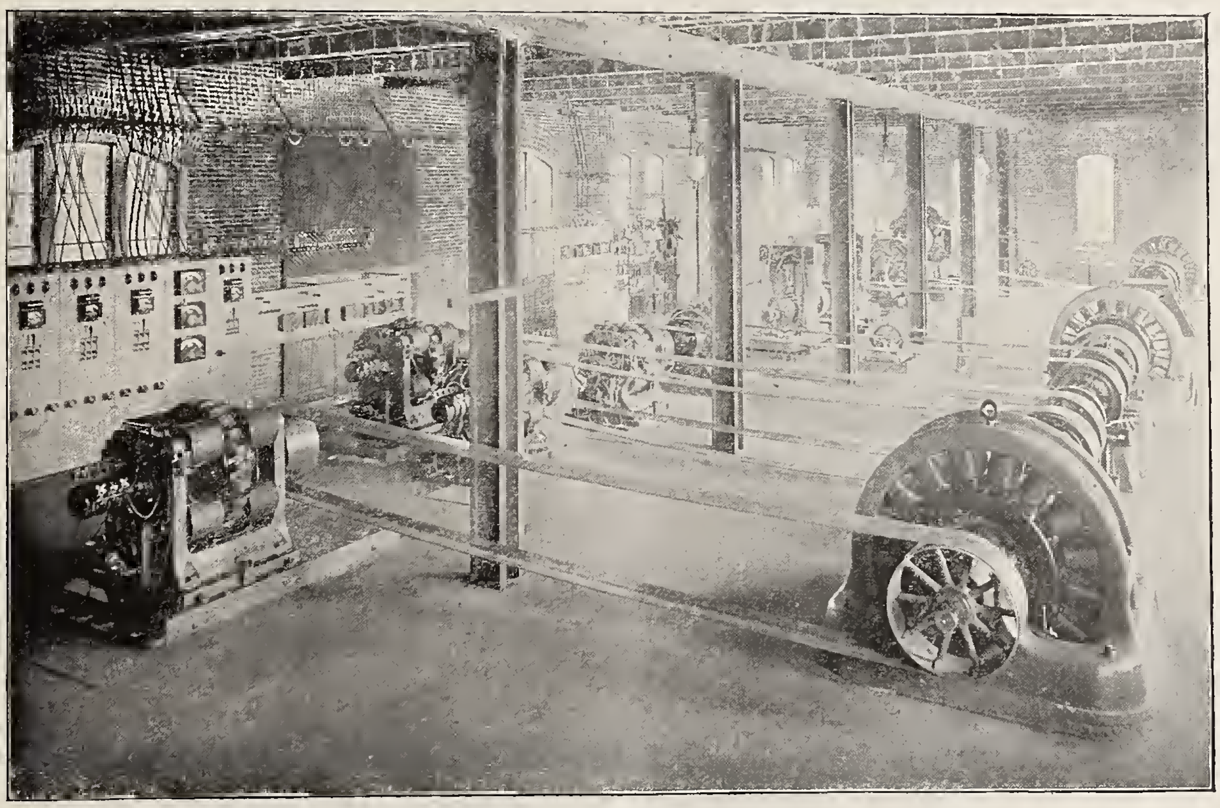
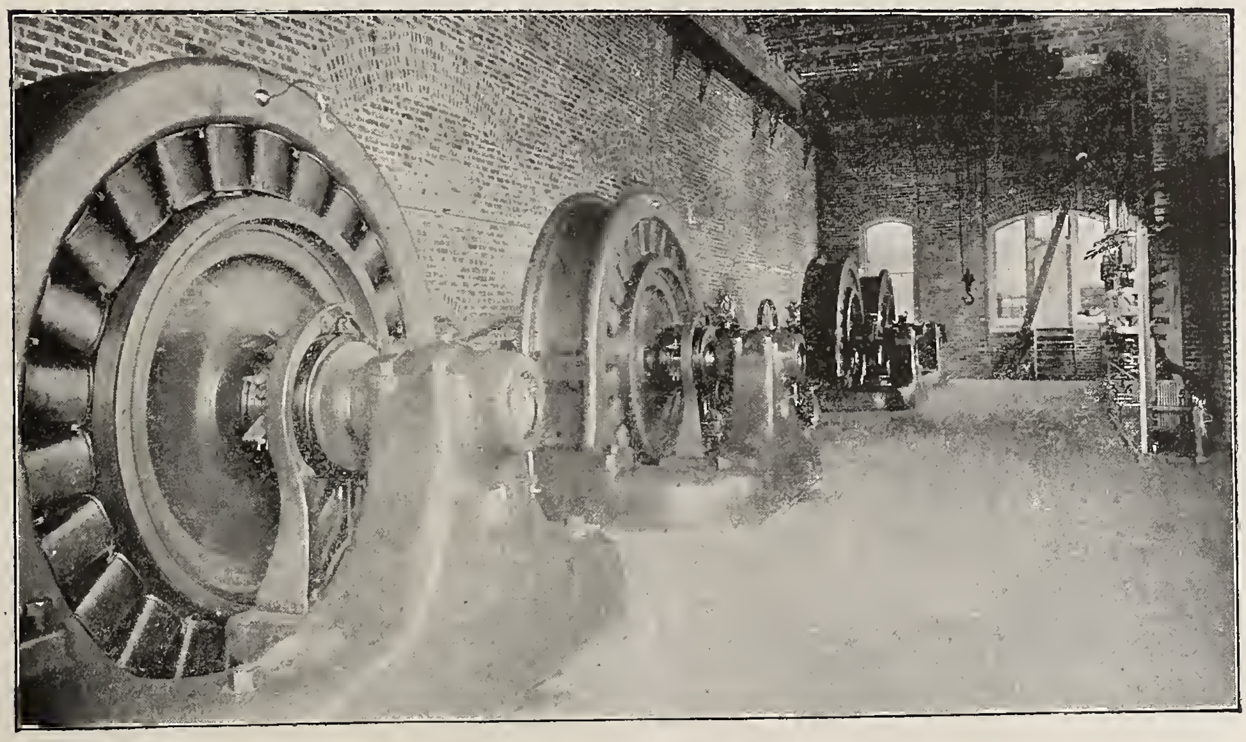


SUB-STATION AT SACRAMENTO.



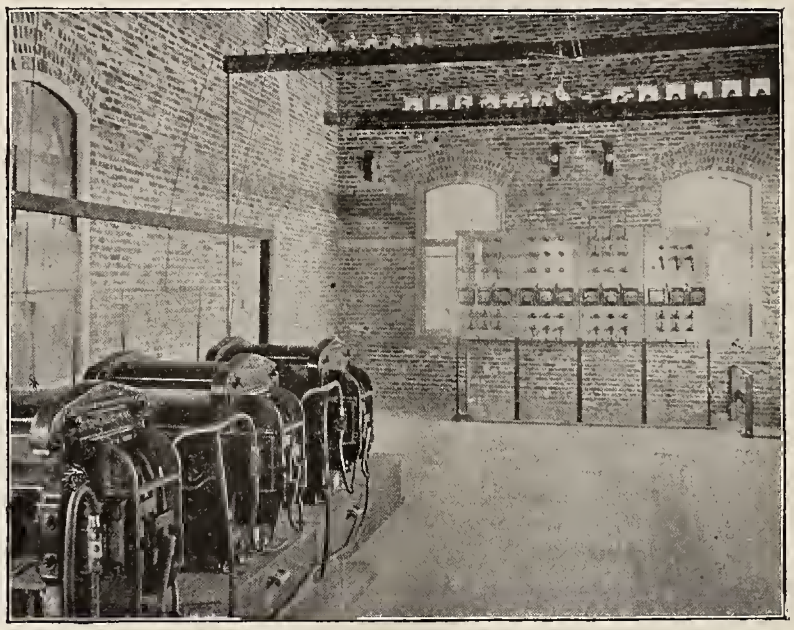
DYNAMO ROOM AT FOLSOM.

A MODEL TRANSMISSION PLANT.

The completion of the power transmission scheme between Folsom and Sacramento is the conclusion of a vast enterprise undertaken in doubt and terminated in a success which has, as it were, galvanized the State of California, and demonstrated not only the tremendous resources at its command, but also the feasibility of electrical transmission over long distance commercially.

The scheme as first conceived by Mr. Livermore, president of the Natona Water and Mining Co., contemplated nothing more than the building of a dam across the American River at Folsom for the storage of water and the irrigation of lands lying in the Sacramento Valley. For twenty-five years intermittent efforts were made to carry out the scheme, and but little progress was effected. Calculations had also been made looking to the utilization of the power derivable from the difference in level of the water, and estimates had placed the possible power available at Folsom extremely high, while dreams of a huge

manufacturing city to utilize this power at that point were indulged in; but the result turned out differently, and instead of the factories being brought to the power, the power is now taken to the factories.



STEP-UP THREE-PHASE TRANSFORMERS AT FOLSOM.

In 1881 the rights of the old company, presided over by Mr. Livermore, were taken over by the Folsom Water Power Co.; work had been begun on the dam, but the development of the scheme appeared so costly that not until

STEP-DOWN TRANSFORMERS AT SACRAMENTO.

the company made a contract with the State of California, whereby convict labor for the construction of the dam and canal was exchanged for the site of a state prison and a certain amount of power, was work really put under way. In 1886 this contract was signed, the plans were expenaded, and under these new plans work was begun in earnest.

The dam is a massive structure of granite laid in Portland cement. It is 650 feet long, 89 feet high in the centre, 87 feet wide at the base, 25 feet wide at the crest and contains about 48,590 cubic yards of solid masonry. It is provided with a heavy wooden shutter or flashboard six feet high, which at high water is lowered into a recess in the crest of the dam. At low water this shutter is raised by hydraulic pistons, the depth of the basin is increased by six feet, and additional storage capacity provided. Normally the dam forms a storage basin or reservoir three and one-half miles long with a capacity of 13,000,000 cubic yards of water.

At each side of the dam are massive granite bulkheads and three head gates, operated by hydraulic machinery; each headgate is 16 feet wide. The canal on the west side, intended principally for irrigation, is not yet completed.

The east side canal is divided into three sections. The first stretching as far as the state canal, where the water falls about seven feet, is cut out of solid granite and extends a distance of 2,000 feet. The second section is 4,000 feet long and, on the completion of this, the terms of the state labor contract were fulfilled. Thus far the canal is built along the face of the cliff. The third section of the canal is an earth ditch, excavated by the Folsom Water Power Co., and is 3,000 feet long. The outer wall of sections two and three carries a broad gauge railroad track.

The total length of the canal is 9,500 feet. Section 1 is 53 feet wide on top and 45 on the bottom. Sections 2 and 3 are each 50 feet wide on top and 40 feet on the bottom. The depth is eight feet. All the water passes through the State Power House, through Leffel turbine wheels, developing some 800 H. P., used for air compressors, electric lighting and other purposes. Thence the water continues on to the Folsom Power House, at the side of which is an immense log basin. Here the jurisdiction of the Folsom Power Co. ceases, and that of the Sacramento Electric and Power Co. begins.

The power house is built on the site of an old placer gold mine, where a fall of 55 feet is available at high water. It is on the west side of the town of Folsom in a cut about 60 feet deep, 100 feet wide, and 150 feet long, from which a channel 40 feet wide leads down to the river. At the power house the canal makes a sharp turn at right angles and widens out into a fore bay 150 feet long, 100 feet wide and 12 feet deep, which forms a settling basin for debris. It is divided into two parts by a stone wall provided with suitable gates, so that one side may be cleaned out while the other is in operation. At the lower end of each section of the bay a sluicing gate connects with the lower river by a sluicing canal, and through this the sand and debris are carried away and kept from the wheels. The hydraulic apparatus, manufactured by S. Morgan Smith, of York, Pa., consists of four pairs of 30-inch wheels of the McCormick horizontal shaft turbine type, each pair of 1,260-H. P. capacity at 300 revolutions

operating under a head of 55 feet. The steel penstocks are eight feet in diameter, and each wheel has two draft tubes. The governors are of the Faesch-Picard type, and these are assisted by heavy fly-wheels fitted to the water-wheel shafts. The hydraulic plant also includes two special horizontal wheels for the exciters. The water, after having passed the turbines, is discharged into a tail, race canal, which will distribute water for irrigation over the country south and west of Folsom.

The power house is a two-story brick building. The water-wheels are placed in the open air between the fore-bay and the wall of the structure, through which the turbine shafts pass. To each shaft is coupled a 750 K. W. (100 H. P.) General Electric three-phase generator—the largest of their type yet constructed. Each is a 24-pole machine delivering current at 60 cycles 800 volts, and running at 300 R. P. M. The exciters are 4-pole, 500-volt, 30-K. W. generators, either one of which is of sufficient capacity to excite the fields of all four generators. From the generators the current passes to the generator switchboard, and thence to nine step-up transformers in the upper story of the power house. The capacity of each transformer is 250 K. W. They are cooled by an air-blast from blowers driven by inductive motors. In these transformers the pressure is raised from 800 volts to 11,000 volts, and the current passes to the high tension transmission lines carried out of the power house through porcelain-lined holes in the wall.

The switchboards are of Tennessee marble, and are so arranged that the generators may be run in parallel or on separate lines as may be desired. The generator swithboard carries the necessary switches, instruments and other apparatus for synchronizing the generators. The boards in the transformer room carry switches for the high and low tension sides of the transformers and switches, and current indicators for the transmission lines.

The pole line is double throughout, and follows the highroad from Folsom to Sacramento, a distance of 24 miles. Each pole carries two cross-arms for two circuits, each circuit consisting of three bare copper wires supported on double-petticoated porcelain insulators, especially designed and made for this installation at the porcelain factory of the General Electric Company at Schenectady. Each insulator before shipment was exposed to a test of not less than 25,000 volts alternating. Each circuit can carry the output of one dynamo, and any dynamo can be drawn on any line. The loss is calculated 7.2 per cent. when transmitting 3,000 H. P.

The telephone line is carried on the same poles as the transmission line and connects the power house with the sub-station in Sacramento. The transmission lines being spiralled every mile, and the telephone wire transposed every fifth pole, no induction is noticeable on the telephone circuits and conversation is not in any way interfered with.

The sub-station is a fireproof two-story brick building on the corner of Sixth and H Streets, Sacramento, having the transformers on the second floor and the dynamo room on the ground floor. In the transformer room the high tension switchboards receive the terminals of the 10,000 volt lines and operate the different combinations of the step-down transformers. These transformers, also ventilated by blowers, vary in size according to the duty required of them, the secondaries delivering current at 125, 500 and 1,000 volts. They number twenty-one; fifteen of 125 K. W. and six of 40 K. W.

The transformers are connected to high and low tension switches on the boards, and from these the current passes to the distributing boards for the synchronous motors, power circuits and incandescent lighting.

In the main or dynamo room of the sub-station a line shaft runs the entire length. To this are directly coupled, through friction clutches, three synchronous motors, each of 250 K. W. capacity, wound for a potential of 500 volts and run at a speed of 450 revolutions. To the line shaft are belted one 200-K. W., and one 90-K. W. multipolar G. E. railway generators and two 100-K. W. Edison bipolar machines, all of 500 volts, and three 100-light and two 75-light Brush arc machines.

In this room are also the switchboards for controlliug the synchronous motors, the railway generators and circuits and the arc dynamos.

For the operation of the synchronous motors 750 K.W. of transformers capacity is utilized, the remainder being used for low and high tension distribution. The low tension current is distributed by a three-phase, four-wire system combining the three-phase and Edison three-wire system, i. e., three wires for the three-phase current and a fourth or neutral wire. Incandescent lights are connected between the neutral and any one of the three other wires, while motors are connected to the three-phase wires, giving at the mains 115 volts for lamps and 200 volts for motors. The feeders for this extensive system pass from the sub-station through a distributing switchboard, which carries potential regulators for maintaining constant pressure at the mains. Additional circuits run from the sub-station at 500 and 1,000 volts, supplying current for lights and motors in the more distant parts of the city.

Power was transmitted for the first time from Folsom to Sacramento on July 14, 1895, for the operation of the Sacramento street railway. On September the 9th, a grand carnival was held to celebrate what up to the present is the longest commercial power transmission ever effected. The remainder of the machinery has since been set up and the installation is now complete.

The power transmitted is now being used for manufacturing purposes, as well as for lighting the city and running the street railway. The power is much cheaper than that by steam, and it is interesting to note that the steam-engine is fast disappearing from Sacramento factories. Among the establishments now using the power are flour mills, box factories, machine shops and hotels.

The largest consumer is the street railway, which over 24½ miles of single and 17 miles of double track operates 32 motor cars and trailors. The Southern Pacific Railway shops employ a large number of motors for draw-bridges and elevators in freight sheds. The Buffalo Brewing Company is about to install five non-synchronous motors to replace steam-engines which have been in use for years, and expect to save 40 per cent. of the present cost of operation by the change.

The entire equipment was carried out by the General Electric Co., whose apparatus is exclusively employed.

This plant is a complete illustration of the possibilities of electrical transmission, every problem to be met with in transmitting power over long distances at high potentials and utilizing it having been solved successfully.

The best indication of this success is reflected in the value of the interest-paying obligations, the bonds of the Sacramento Electric Light and Power Co. finding ready purchasers at par, although the plant has been in operation less than one year.

THE GOLD PRODUCT.

It is now evident that the production of gold for the next 50 years will be altogether unprecedented. This production has been vigorously stimulated by fresh discoveries of mines, by new and cheap mining processes and by the fall of silver, leading miners to pay greater attention to the other metal. The operation of the latter factor is best seen in Colorado, where the production of gold rose from $5,300,000 in 1892, to $7,527,000 in 1893, and to about $12,000,000 in 1894. The production of 1895 in Colorado is confidently expected to reach $20,000,000. The director of the mint is of the opinion that the production of the United States rose from $33,014,981 in 1892 to about $39,500,000 in 1894, while other good authorities put the production of 1894 at $50,000,000. The annual report of other great producing coun-

tries shows a large increase of late years. In his notable article in the "North American Review," Mr. Preston states that the world's production of gold for 1893 was the "largest in history, amounting in round numbers to $155,522,000." The product of 1894, however, very largely exceeded—probably by 25%—the product of 1893. There is scarcely any assignable limit to the gold known to exist in the world, or even in the United States. It is said that simply by the removal of the restrictions on hydraulic mining California can produce half a billion of of gold. The quantity easily obtainable in Colorado is stupendous. Other parts of the United States are also rich, while Australia and Russia probably possess a stock equal to our own and are increasing the annual output every year.

But the most surprising, and, so to speak, revolutionary facts regarding gold that have recently come to light are those concerning the great Witwatersrandt mines of South Africa. There the gold is found in enormous quantities and in a cheaply workable form in a new geological situation—"in strata the component parts of which are pieces of quartz held together by a clayey cement."—Popular Science.

WHAT ELECTRICITY WOULD SAVE.

An expert on the application of electricity as a motive power in railroading not long since furnished an interesting series of articles on the subject, concluding with an estimate of what it would cost to furnish the Pennsylvania Railroad with an electrical equipment. There were four methods to determine the amount of power required, but the most accurate was taken as a basis. This was done by taking the coal consumption and assuming a certain consumption per horse-power hour. This gives 147,573 horse-power required. This estimate is taken as a basis, and 25% is added to allow for increased traffic at certain seasons of the year, and again 25 % to cover the heaviest demands during the day at such times. The grand total is 230,585 horse-power. As this is the amount estimated as required delivered on the track, it is considered necessary to have 385,000 horse-power in the power stations.

The plan of estimate then divides the line into 60 sections of 45 miles of road and gives each section a power plant of 6,500 horse-power each. The total cost for the 60 stations is given at $37,620,000. The cost of 1,000 motors to take the place of 1,800 engines is added and the cost of the total electrical equipment of the system amounts to $43,620,000. The author says: "This estimate is only a rough approximation; anything more in detail or more accurate could not be given unless we had full information as to amount of traffic over each mile of road, location of curves, grades, etc.," but also adds that the figures "are undoubtedly much nearer to the actual cost than a mere good guess, and enables us to form some idea of what the transformation of a large trunk line railway system from steam to electricity would involve in the way of expenditures."

The cost of operation of this plant is estimated carefully at $2,724,800, and subtracting this from the saving in operating expenses already given at $7,606,442.24, the net annual saving is $4,881,642.24, or more than 11% on the total cost of the installation.

This is certainly a great showing for electricity. If the new power would save 16.4% of the operating expenses on the Pennsylvania Railroad, it should surely be adopted. As the expert referred to says himself, if railroad managers were convinced that these claims are true, a transformation of their lines would at once be undertaken; but they are not convinced, and will not be until they learn the facts in their own way, and that way will be by going slowly and trying a branch road here and another there until they have obtained a sufficient amount of data from actual experience to dispel all doubt. Then steam may disappear from the railroads and the adoption of electricity be as general and rapid as it has been on the street car lines. Already several railroads are feeling their way by experimenting on branch roads with light equipments. This work will no doubt be followed up by the equipment of more important branches with heavier rolling stock, until a sufficient amount of practical data is obtained to justify a change of entire systems.—American Manufacturer.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—ELECTRIC CARRIAGE.

Brooklyn, N. Y., Aug. 18, 1896.

To Editor Electrical Age.

Dear Sir:—Being asked the question of what is required to run an electric carriage that needs 300 watts to run it; what size motor, connections, etc., are required; in fact, let me know all there is about it and oblige a subscriber. H. A. R.

(A.)—A $\frac{1}{2}$-HP. motor takes a little more than 300 watts. To start a carriage more force must be exerted than is required to run it; so at least a 1-HP. motor would be necessary. The connections are the same as those of any other motor, a starting box being required. The power applied is generally obtained from storage batteries. To tell you all about it would be embarrassing to others desiring to use this column. A paper called "The Horseless Age," might give you a more elaborate and detailed account.

(Q.)—150-HOUR ARC LAMPS.

Newark, Aug. 12, 1896.

Electrical Age Publishing Co.

Dear Editor:—The long life of carbons used in the new closed globe lamps are interesting to me in this respect: I would like to know why they burn so long and where the advantage otherwise lies. Yours truly,

L. W. Cartwright.

(A.)—The carbons start an arc in a closed globe. The arc quickly burns up the oxygen; the carbon being intensely hot combines and forms an oxide. The carbons, therefore, are protected from oxygen from the outside and only wear away due to the influence of the arc upon them. This wasting away is very gradual; hence the long life. Not only is carbon saved, but labor and some power, in certain cases. The gain is quite definite and in all probability this new form of lamp will be universally used in due time.

(Q.)—WATER FROZEN BY ELECTRICITY.

San Francisco, Cal., Aug. 2, 1896.

Electrical Age.

To the Editor:—Can water be possibly frozen by electricity? Kindly oblige a constant reader.

Frank A. Martens.

(A.)—Water can be frozen by electricity in two ways: 1st. By applying a motor to an ice-cream freezer, filling it (the freezer) with water; 2d. By experimenting with two dissimilar metals, joined, through which a current is passed. One junction, if the series is large, will heat; the other, cool. Water has been well frozen by this means.

(Q.)—DYNAMO SPARKS.

Albany, N. Y., July 15, 1896.

Editor Electrical Age:

Dear Sir:—Can you give me any assistance in stopping the sparking at the bushes of my dynamo. The machine is about three-quarters loaded when the sparking becomes very violent. I have tried everything without success. Kindly let me know at once.

Yours very truly, John Maguire.

(A.)—Try to reduce the sparking by shifting the brushes. If this is ineffectual strengthen the field, because the armature reaction is probably the cause of it, and it will be diminished by this means. If the machine has not sparked always, the trouble is local—somewhere in the armature. Give it a thorough test and let us hear from you.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 442.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

Fig. 3 shows the curves given by the English standard candles. In curves III. and IV. the candles were lighted at their tops. The wicks flared up and gave a high point on each curve, which in the case of curve IV. is not shown on the plate. The flames then increased gradually to their normal size, which was reached after about 15 minutes. Curves III. (*a*) and IV. (*a*) are continuations of III. and IV. The candles were allowed to burn during the interval between the curves, which in the case of III. and III. (*a*) was 45 minutes, and in the case of IV. and IV. (*a*) was 55 minutes. During III. the room was rather more draughty than during III. (*a*), and the effect of the draughts is seen in the much larger number of small irregularities in the former than in the latter curve. During the interval between IV. and IV. (*a*) the height of the flame of the candle was found to vary between 43 and 48 mm.

Curve I. was taken with the portion of candle left over from IV. and IV. (*a*). It was lighted, its wick being already charred and its crater formed, and readings were taken immediately. Curve II. was taken with the lower half of the candle used in getting III. and III. (*a*). The bottom, *i. e.*, the larger end of this, was hollowed out to expose the wick, and readings were taken after the candle had been burning long enough to come to its normal light-giving power. The agreement in the amount of radiation of the candle burned in this way, with the amount when burned from the smaller end, shows that the variation in the diameter of the candle has little if any influence on the intensity of the light emitted.

One marked peculiarity which characterizes, to a great-

TABLE II.

RESULTS OF BOLOMETRIC MEASUREMENTS (BRITISH CANDLE).

	Time: Minutes on curve.	Mean ordinates and their mean.	Deviations from the mean ordinate of the curve.	Deviations reduced to percentages.	Deviations from mean ordinate of all the English candle curves.	Deviations from general mean reduced to percentages.
Curve I.	15–20	41.68	−10.4	−2.43	+0.59	+1.44
	20–25	44.68	+1.96	+4.58	+3.59	+8.72
	25–30	40.84	−1.88	−4.40	−0.25	−0.61
	30–35	43.39	+0.67	+1.57	+2.30	+5.59
	35–40	43.71	+0.99	+2.32	+2.62	+6.37
	40–45	42.04	−0.68	−1.59	+0.95	+2.31
		42.72	Correction for rate of burning = −0.70.			
Curve II.	45–50	39.24	−1.77	−4.32	−1.85	−4.50
	50–55	37.85	−3.16	−7.70	−3.24	−7.87
	55–60	39.12	−1.89	−4.61	−1.97	−4.79
	60–65	40.44	−0.57	−1.39	−9.65	−1.58
	65–70	40.76	−0.25	−0.61	−0.33	−0.80
	70–75	42.85	+1.84	+4.48	+1.76	+4.28
	75–80	43.52	+2.51	+6.12	+2.43	+5.92
	80–85	43.20	+2.19	+5.34	+2.11	+5.13
	85–90	42.11	+1.10	+2.68	+1.02	+2.48
		41.01	Correction for rate of burning = +0.05.			
Curve III.	15–20	43.04	−0.54	−1.25	+1.95	+4.74
	20–25	42.88	−0.70	−1.62	+1.79	+4.35
	25–30	42.82	−0.76	−1.76	+1.73	+4.21
	30–35	42.18	−1.40	−3.23	+1.09	+2.65
	35–40	43.23	−0.35	−0.80	+2.14	+5.20
	40–45	44.80	+1.22	+2.80	+3.71	+9.02
	45–50	43.58	0	0	+2.49	+6.06
	50–55	44.30	+0.72	+1.65	+3.21	+7.80
	55–60	45.38	+1.80	+4.13	+4.29	+10.45
		43.58	Correction for rate of burning = −0.34.			
Curve III. (*a*).	60–65	43.25	+0.23	+0.53	+2.16	+5.25
	65–70	43.52	+0.50	+1.16	+2.43	+5.91
	70–75	42.82	−0.20	−0.47	+1.73	+4.21
	75–80	43.68	+0.66	+1.54	+2.59	+6.30
	80–85	42.82	−0.20	−0.47	+1.73	+4.21
	85–90	42.04	−0.98	−2.28	+0.95	+2.31
		43.02	Correction for rare of burning = −0.34.			
Curve IV.	15–20	38.65	+1.42	+3.82	−2.44	−5.94
	20–25	39.84	+2.61	+7.01	−1.25	−3.04
	25–30	38.07	+0.84	+2.26	−3.02	−7.35
	30–35	35.76	−1.47	−3.87	−5.33	−12.95
	35–40	35.72	−1.51	−4.05	−5.37	−13.08
	40–45	37.04	−0.19	−0.51	−4.05	−9.84
	45–50	35.84	−1.39	−3.75	−5.25	−12.78
	50–55	37.16	−0.07	−0.02	−3.93	−9.55
	55–60	36.96	−0.27	−0.72	−4.13	−10.05
		37.23	Correction for rate of burning = +0.45.			
Curve IV. (*a*).	60–65	38.26	−1.47	−3.70	−2.83	−6.88
	65–70	39.04	−0.69	−1.74	−2.05	−4.99
	70–75	38.26	−1.47	−3.70	−2.83	−6.88
	75–80	40.84	+1.11	+2.80	−0.25	−0.62
	80–85	40.84	+1.11	+2.80	−0.25	−0.62
	85–90	41.16	+1.43	+3.60	+0.07	+0.17
		39.73	Correction for rate of burning = +0.45.			

Mean ordinate of all the English candle curves is 41.09.
Mean ordinate of all the English candle curves corrected for rate of burning is 41.05.
Mean ordinate of all the English candle curves corrected for rate and reduced to true deflections is 41.06.

er or less degree, all these curves, is the succession of sudden drops followed by gradual rises to a maximum. In the case of the drop in curve IV. at 55 minutes, the change amounted to 15% of the total deflection, and in other instances the change was nearly or quite as large. The reason for these drops is to be looked for in the action of the wick, which, as the candle burns down projects farther above the spermaceti, causing a tall flame. Finally, by reason of charring and because of its own weight, it bends over and the end burns off. The flame following the wick becomes shorter.

Since the wicks of English standard candles are very uniform in construction, these drops succeeded each other after nearly regular time intervals of about 3 minutes.

A confirmation of these results, together with conclusive evidence of the legitimacy of the bolometric method of studying light sources will be found in section IV. of this report.

(To be continued.)

Recent Experiments in Acetylene.—H. Le Chatelier, a French chemist, in experimenting with acetylene, finds that mixtures with air are explosive when they contain more than 2.8 and less than 65% of acetylene, mixtures of acetylene and oxygen, when they contain more than 2.8 less than 93% of acetylene. The diameter of the tube from which it is ignited is commented upon. In tubes of less diameter than 40 mm. (1.57 ins.), these limits are gradually narrowed until in tubes of 0.5 mm. (0.02-in.) the propagation of the flame ceases altogether. In mixtures of air and acetylene, when the percentage of the latter is less than 7.7, the flame is yellowish-brown and feebly luminous, and the products of combustion are carbolic anhydride and water. When the percentage of acetylene is from 7.7 to 17.4, the flame is pale blue with a yellowish-brown edge, and carbonic anhydride, carbonic oxide and water are formed. Between 17.4 and 20% of acetylene cause very imperfect combustion, carbonic oxide, hydrogen, carbon and acetylene being residual products. When over 20%, the disposition of soot is very marked, and the flame, though strongly luminous, is of a reddish color. The rate of propagation of the flame is 0.1 metre (3.9 ins.) per second, with 2.9% acetylene, increases rapidly to 5 metres (197 ins.), slowly to 6 metres (236 ins.), with 9 to 10%, and then decreases rapidly to 0.4 metre (15.7 ins.) with 22%, and slowly to 0.5 metre with 64%. The temperature of ignition is very low, viz., about 480° C., most other combustible gases requiring 600° C. for ignition. The temperature of the flame is very high. Burned with its own volume of oxygen, acetylene gives a temperature of about 4,000° C., or about 1,000° C. more than the oxyhydrogen flame.

ROENTGEN RAYS.

New Incandescent Lamp.—A new filament for incandescent lamps has been described as made of hygroscopic asbestos paste which, after being made in sheets .3 mm. thick, is cut into strips 6 cm. wide, and impregnated with a 30% solution of platinum chloride. It is then passed through a saturated solution of sal-ammoniac, dried in hot air, and then heated in a Bunsen flame, which converts the platinum solution into a platinum sponge. It is further impregnated with a 20% solution of magnesium chloride and heated, which process is repeated until the plate is covered with a uniform coating of magnesia, and it is finally dipped into a 10% solution of cerite nitrate. The magnesium coating protects the platinum, and the light-radiating properties of the cerite metals are much greater than those of carbon.—American Manufacturer.

Forty-two Tons Pressure.—An experiment was recently made in Vienna in order to test the relative resistance, under pressure, of the hardest steel and the hardest stone. Small cubes of corundum and of the finest steel were subjected to the test. The corundum broke under the weight of six tons, but the steel resisted up to 42 tons. The steel split up with a noise like the report of a gun, breaking into a powder, and sending sparks in every direction, which bored their way into the machine like shot.—N. E. Lumberman.

—Few people have any idea of the wonderful amount of strength possessed by members of the beetle family. Felix Plateau has made experiments which show that a common dor beetle can draw 500 times its own weight, and a stag beetle has been known to escape from under a box weighted with a book 1,700 times greater in weight than the insect's body. If horse's strength was as great comparatively as that of a common flea he could draw a dead weight of 800,000 pounds.—N. E. Lumberman.

Gas Motor Cars in Berlin.—A gas motor car of the Dessau Gas Railway Company is now on exhibition in the German Industrial Exposition at Berlin, together with a portable gas compressing engine which furnishes compressed gas to run the car. Since May 1 a similar car is making regular daily runs on the street car line Charlottenburg-Knie and renders very satisfactory service.—American Manufacturer.

—The range of the human voice is quite astounding, there being about 9 perfect tones, but 17,592,186,044,515 different sounds; thus, 14 direct muscles, alone or together, produce 16,383; 30 indirect muscles ditto, 173,741,823, and all in co-operation produce the number we have named; and these independently of different degrees of intensity.—N. E. Lumberman.

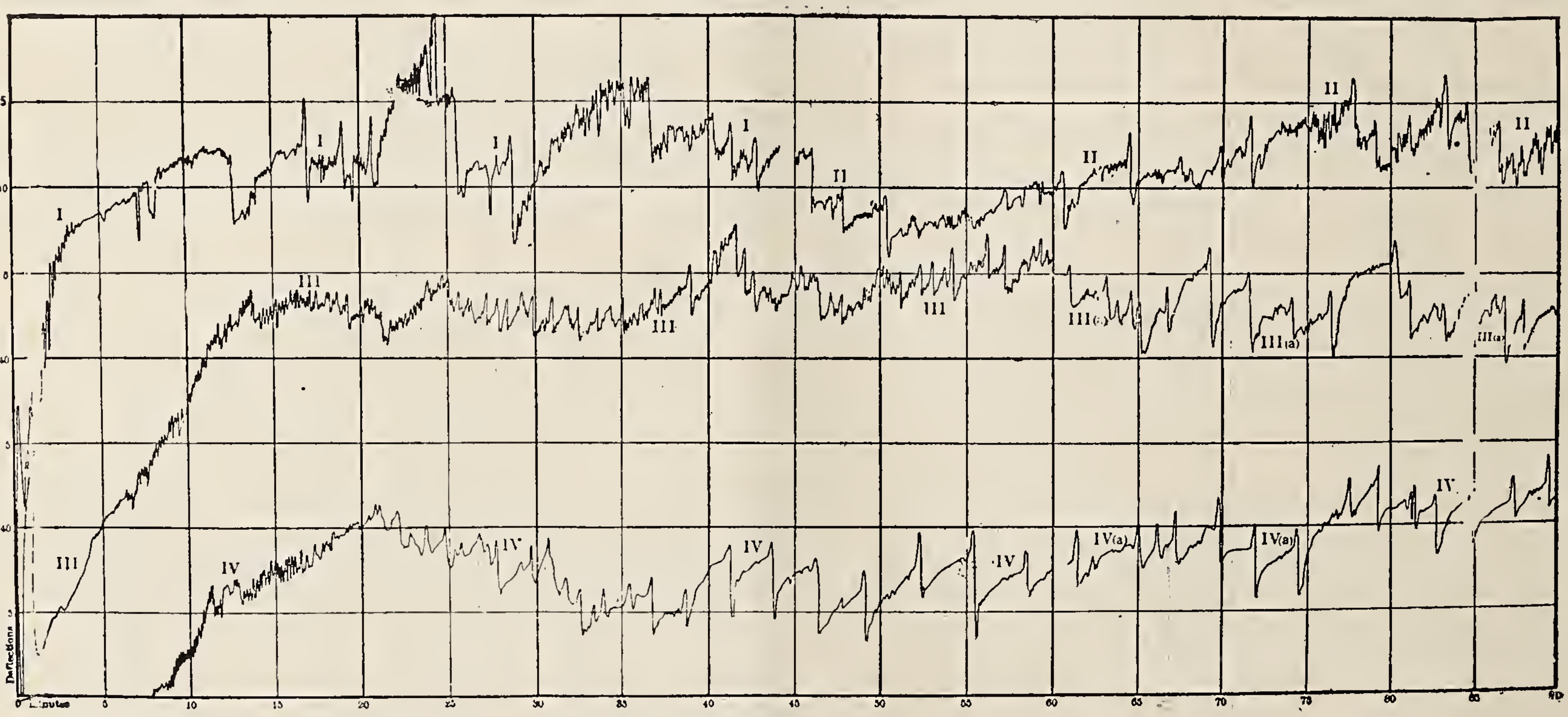


Fig. 3.

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CONTENTS.

	PAGE
EDITORIALS	
The Modern Alchemist	475
The Electric Light in the Arctic Regions	475
GENERAL SUBJECTS	
A Model Transmission Plant	469
Standards of Light	473
Alternating Currents	476
MISCELLANEOUS	
The Gold Product	471
What Electricity Would Save	472
The Fusibility of Platinum in a Carbon Furnace	475
How Much Silver Can We Coin	479
Silver Turned Into Gold	482
EXTRACTS	
Roentgen Rays	464
TRADE NOTES	
The Application of Roentgen Rays	478
The World Dynamo	480
The Acme Electric Bicycle Lamp	480
Yale & Towne's Chain Blocks	482
Possible Contracts	483
Telephone Notes	483
New York Notes	484
NEW CORPORATIONS	483
New Telephone Companies	483
PATENTS	483
Telephone Patents	483
INQUIRY COLUMN	472

THE MODERN ALCHEMIST.

This is a very prosaic world. We believe in nothing that we consider incapable of proof. Yet the traditional and ancient spirit still prevails. Perpetual motion cranks are a drug on the market. The search after an elixir of life has not ceased. Again the wheel has turned and produced an old-time product, a transmuter of metals, a modern alchemist. Modern alchemists are as dangerous to-day as they were of old. They are prepared to conquer incompetent opposition by an array of so-called scientific evidence that cannot be refuted by the layman. His mixtures have names, his concoctions are embellished by unending formulae and his statements supported by the ordinary phenomena of nature. The public are helpless, their attacks fruitless, their opinions valueless. Dr. Emmens, of New York, claims to have discovered a process by which silver can be transmuted into gold. He cannot make public his processes now, but will say that the gold is dissolved in a liquid, as sugar into water. Let us wait. When the process is complete and the product marketable, our silver dollars will entirely disappear. Everybody will have gold. Owners of silver mines will change their faith. They may not know what to say. They might become ardent bimetallists. After silver has been turned into gold it will be a simple matter to change the other metals. The color of copper is much nearer to gold than silver, and the process may be more easily applicable. Does Dr. Emmens think he can turn brass into gold?

THE ELECTRIC LIGHT IN THE ARCTIC REGIONS.

The altar of ambition is heaped with human sacrifices. No more noteworthy example of the dangers through which an ambitious man will go is to be found than in the progress of Dr. Nansen towards the North Pole. A physical hardihood, a spirit of intrepidity is required which will outlive the gravest perils, the most frightful dangers and the most despairing of conditions. Dr. Nansen returned when within 250 miles of the pole. He had approached nearer to it than any living man. The great ice-barrier, and the absolute desolation would quickly unnerve any but an iron heart. There is in his journey's history a few facts of interest to ourselves. He attributes much of the comfort he found to the use of an electric current. A small outfit composed of windmill and dynamo was the means by which he lit the icy wastes and produced heat sufficient for his needs. The addition of a hand device enabled him at any time to drive the generator. A stranger sight we cannot imagine. Vast tracts of ice stretching for miles on all sides like a great winding sheet. A death-dealing coldness; this heroic man, his eyes fixed afar on the barren wastes, the interminable hummocks,the seemingly unending wilderness of snow and ice, struggling northward step by step. Dante has left untouched such frigid horrors. The garland of immortal fame is still secure. It rests as yet upon the broad bosom of the great ice king.

THE FUSIBILITY OF PLATINUM IN A CARBON FURNACE.

Victor Meyer, in the "Chemical News," remarks that it has been recently pointed out that the oft-repeated assertion of the fusibility of platinum in a furnace fed with carbon and air has not been incontrovertibly demonstrated. As the vessels used are in general more or less injured at the high temperature of the experiment, or cannot be considered as perfectly fitting, it is not impossible that the flames of the furnace or burning particles of carbon may come in direct contact with the platinum. But, as is well known, in almost every flame there is a hot region having a higher temperature than the melting point of platinum. A capillary platinum wire can be fused in the hottest part of the flame of a candle. The problem of fusing platinum in the carbon blast furnace in vessels perfectly closed on all sides does not seem to have been hitherto solved in a manner which excludes all doubt.

In the course of the pyro-chemical investigations which for some time have engaged Dr. von Rocklingshausen, Dr. Locke, and the author, they undertook the task, among other things, of obtaining a firebox in which platinum can be fused while an alloy of 25% iridium and 75% platinum remains unattacked. They needed such a firebox for determinations of the density of gases and measurements of temperature, which are undertaken with the apparatus made by Haeraeus of platinum-iridium. For this purpose they used a furnace quite similar to the blast furnace used by C. Langer although of larger dimensions, and provided with a larger wind chest. As fuel they used retort graphite, broken up in pieces of the size of a hazel nut. The air was supplied by a very powerful blast. Under certain conditions this furnace answered the purpose required, as was proved by the following experiment:

They found a block of perfectly refractory earth in which were two depressions, so that it might be regarded as a double crucible with very thick sides. In one of these depressions was laid a piece of sheet platinum, and in the other a sheet of metal of equal size of the alloy of 25 parts iridium and 75 platinum, which had previously been proved to be considerably less fusible than platinum. The block was then perfectly closed by means of a top of the same refractory earth, so that the whole formed a massive stone-like mass with two cavities. On burning, the crucible thus formed was converted into a stone per-

fectly solid and hard. After it had been heated in the above graphite blast furnace, and allowed to cool, it was broken open. The platinum was melted into a ball, but the platinum-iridium alloy was perfectly unaffected. Hence, it is claimed that now the fusibility of platinum in thick-sided crucibles with a carbon blast furnace is indubitably established.—American Manufacturer.

ALTERNATING CURRENTS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

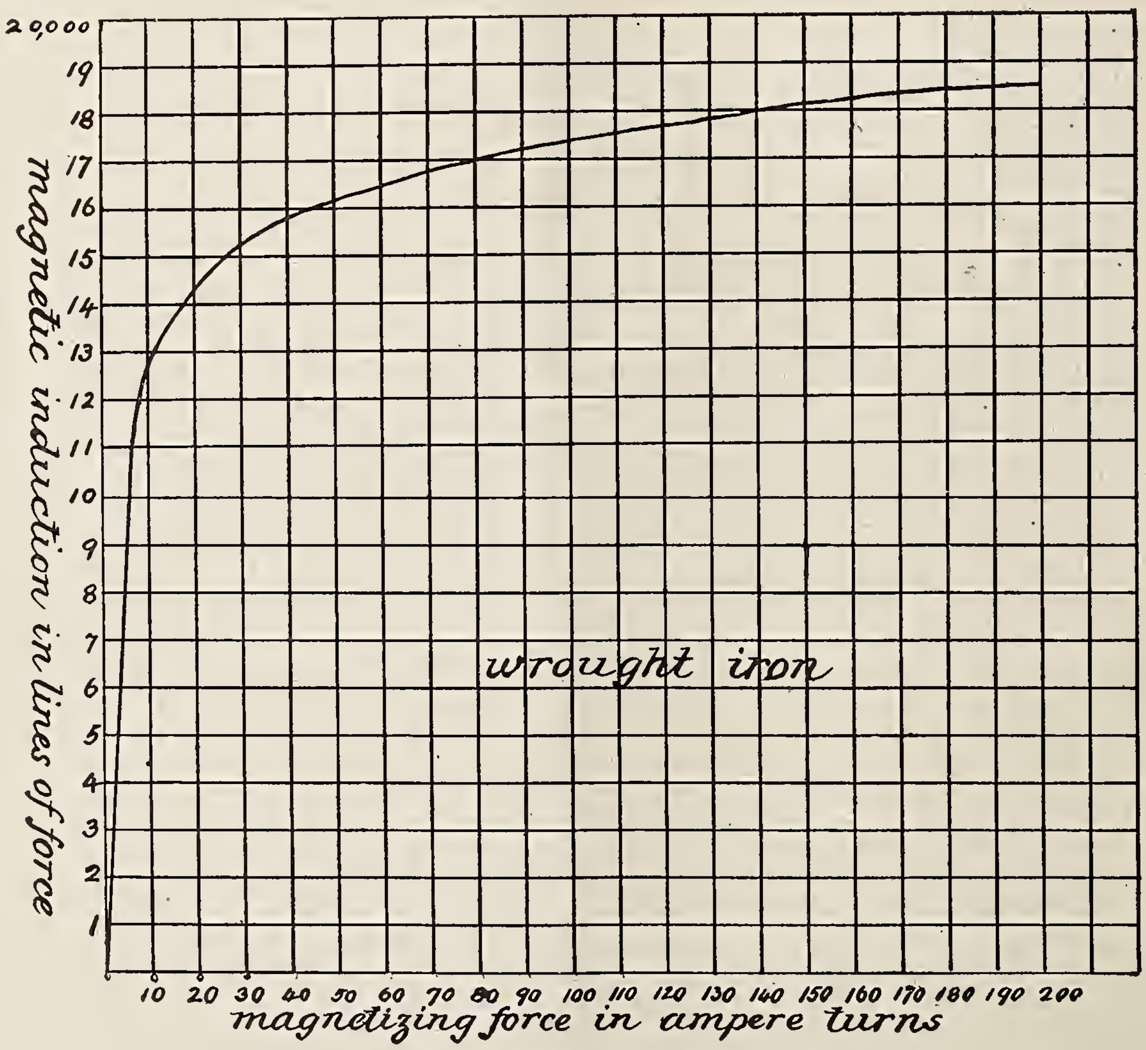
The different values of the current does not prevent the instrument maker from constructing meters which will measure the "square root of the mean square." The pulsations of an arc light current practically consist of a series of waves always passing onward in one direction but virtually similar in general appearance to an alternating wave. The rapidity with which a series of alternations pass back and forth is productive of several strange effects. A piece of metal of any description when thus influenced becomes warm and possibly very hot. When a coil of wire containing a core of iron is magnetized and demagnetized by an alternating current a peculiar hum is heard. The more rapidly the current reverses the louder the hum, until its resonant sound is like a low musical tone. The iron within the core will become very warm and have a curious effect upon a piece of metal placed near it, repelling it with considerable force and likewise exciting heat in it. The explanation given of the effect produced in iron is twofold.

First: It is observed that the magnetization consumes power. A piece of iron magnetized by a current flowing in one direction will consume more power to bring it back again to a neutral condition than it did in becoming magnetic. This consumption of power is called *hysteresis*, and is due to a certain molecular condition causing a rigidity of the particles and therefore depending upon the quality of the iron for its extent. A piece of steel would consume more power than soft wrought-iron while undergoing the process of magnetization and demagnetization; a well annealed piece of iron, less than the ordinary wrought-iron not treated in this manner. Mr. Kapp has given figures on the amount of energy consumed in a mass of iron by hysteresis. The reversals occurred 100 times per second, giving 200 changes. These results are true for the iron of a transformer.

(At 100 complete periods a second.)

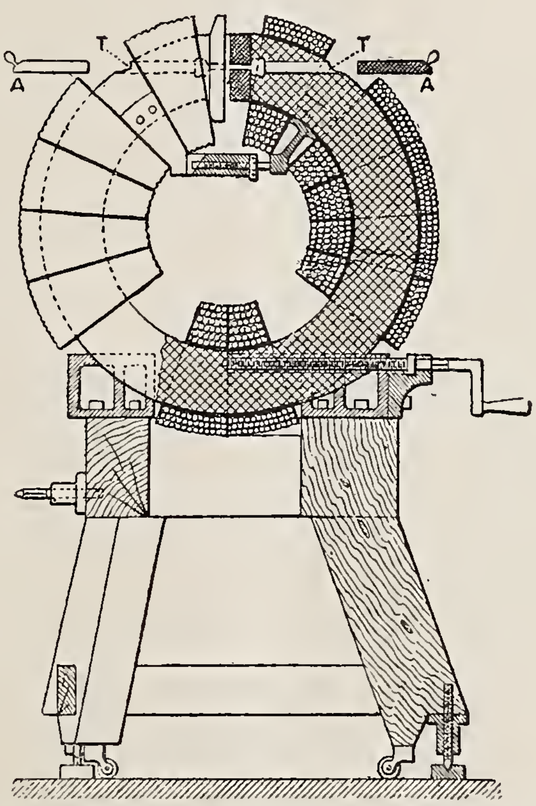
Lines of force in iron.	Volts per ton of iron.	Horse-power wasted in heat per ton of iron.
2,000	650	.87
3,000	1,100	1.48
4,000	1,650	2.21
5,000	2,250	3.02
6,000	2,900	3.89
7,000	3,750	5.03
8,000	4,450	5.97
9,000	5,550	7.43
10,000	6,650	8.90

This phenomenon called hysteresis will have such an effect upon the iron that only after the magnetizing force has been partially removed the influence steals over the iron and develops lines of force. A difference of phase, therefore, exists between the magnetizing force and the lines of force produced, or what might be called the resultant magnetization. The other effect acting upon the iron is much simpler in its nature. It is due to *eddy* currents, small whirling currents induced in the iron by the fact that lines of force are cutting it, passing and repassing so rapidly that an electromotive force is set up and necessarily a current. To avoid these eddy currents the iron is subdivided into thin sheets or used in the form of wire. This treatment will not in the least reduce the hysteresis, as that is entirely due to the molecular condition of the iron, but will reduce the eddies by insulating the parts of the metal from each other. The currents then produced have so short a circuit to flow in that their



CURVE OF THE MAGNETIZATION IN WROUGHT IRON.

volume is very slight and the heat very little. The hysteresis in iron depends upon the extent to which it is magnetized and naturally upon the rapidity with which these changes occur. These, in addition to the fact that it likewise depends upon the quality of the iron, enable us to reduce or increase it at will or hold it well in check.



DEVICE FOR PRODUCING INTENSE MAGNETIC FIELDS.

The importance of understanding these effects and their causes is clearly seen in the design of a transformer. A *transformer* is a device by means of which a given electromotive force can be increased or decreased.

There are two classes of transformers:

Step-up transformers,
Step-down transformers.

In city circuits the step-down transformer is generally used. A pressure varying from 1,000 to 2,000 volts is applied to it and reduced down for purposes of light or power to 50 or 100 volts as required. The transformer consists of a frame of iron upon which are placed two coils of wire. The coils link in with a complete magnetic circuit formed by the iron. The iron is generally used in thin plates and the two coils thoroughly insulated from it and each other are linked by it. Thus, there may be a circle of iron and a coil on each side of it at the opposite extremities of a diameter. The resistance and turns of each coil are duly proportioned to receive and give individually the proper current and pressure.

The iron being continually subject to violent reversals, must create the least possible heat and absorb little or no power. To do this both the hysteresis and eddy currents must be kept down to a certain low but definite value.

OPACITY IN GLASS.

An interesting note on the cause of opacity in opaque glass is communicated by Prof. F. Knapp to a recent number of "Illustriertes Fachblatt," Phosphate of calcium plays an important role as a constituent of certain kinds of opaque glass. Mixed with 13% of phosphate of calcium and upwards to 20% melts to a clear, liquid glass which, when worked rapidly, also cools to a transparent glass. But if the glass be now reheated it becomes white and opaque. When examined under the microscope it has the appearance of a finely divided precipitate in the glass, the particles being so fine that no definite form is shown under the microscope. If the glass is allowed to cool gradually for 24 hours, crystals separate out of the glass either attended or unaccompanied by the milky appearance produced by reheating, as above described. These will dissolve in hydrochloric acid, and when thus dissolved and analyzed are found to consist of phosphate of calcium. In a similar manner, oxide of tin is used to produce opaque enamels. This compound is one of those readily absorbed by glass in the smelting. It acts in a manner similar to the phosphate of calcium. Glass with 7% and upwards to 20% of oxide of tin remains transparent when cooled and worked rapidly, but when slowly cooled it becomes opaque, and under the microscope it shows long needle-shaped crystals. These are not attacked by hydrofluoric acid and consequently can be separated from the glass surrounding them. When subject to analysis they are found to consist of pure oxide of tin. Ordinary transparent glass itself also presents similar phenomena. When melted and worked in the ordinary way it cools down to a transparent amorphous mass, homogeneous throughout. But when the glass is allowed to stand in the molten condition too long, or is allowed to cool down very slowly, it will also become opaque, or show the crystals separated out of the glass made intentionally opaque. This tendency is more or less marked as the composition of the glass is more or less favorable to the retaining of the substances in the solution in the glass.—American Manufacturer.

HOW MUCH SILVER CAN WE COIN?

The Superintendent of the Philadelphia Mint has made an important statement to the effect that if a free silver coinage law should be enacted at this time it could not be enforced. He points out that it would be a physical impossibility for the government to coin the silver which under the provisions of such a law would be dumped into the mints. The government vaults, now contain 200,000,000 ounces of silver bullion, and at the present minting capacity it would require five or more years to coin this into money before an ounce of the bullion which would be poured in under a free silver law could be touched. The Superintendent claims that ten years would be required to increase the capacity of the mint, during which time bullion would be accumulating in such quantities that the mints would never be able to use it up. The answer of the average silverite may be anticipated. He wants the government to provide storage for vast accumulations of bullion, and then issue silver certificates to the coinage value of the bullion, at a ratio of 16 to 1. Really he does not want silver at all. In fact, he would rather not have it. He wants paper.—American Manufacturer.

THE APPLICATION OF ROENTGEN RAYS.

The medical fraternity now consider the use of X-rays indispensable for the rapid and correct location of fractures, bullets and other foreign bodies. It is not only applied in the examination of bones, but in the diagnosis of diseases affecting organs entirely hidden from the eye. Deap-seated troubles have been thus brought into sight, and a remedial treatment otherwise impossible frequently successfully adopted.

Deformities and ossifications of all descriptions are readily identified and characterized by all the well-known attendant peculiarities seen until recently only in the dissected form, but now exposed to the actual gaze while clothed with living flesh.

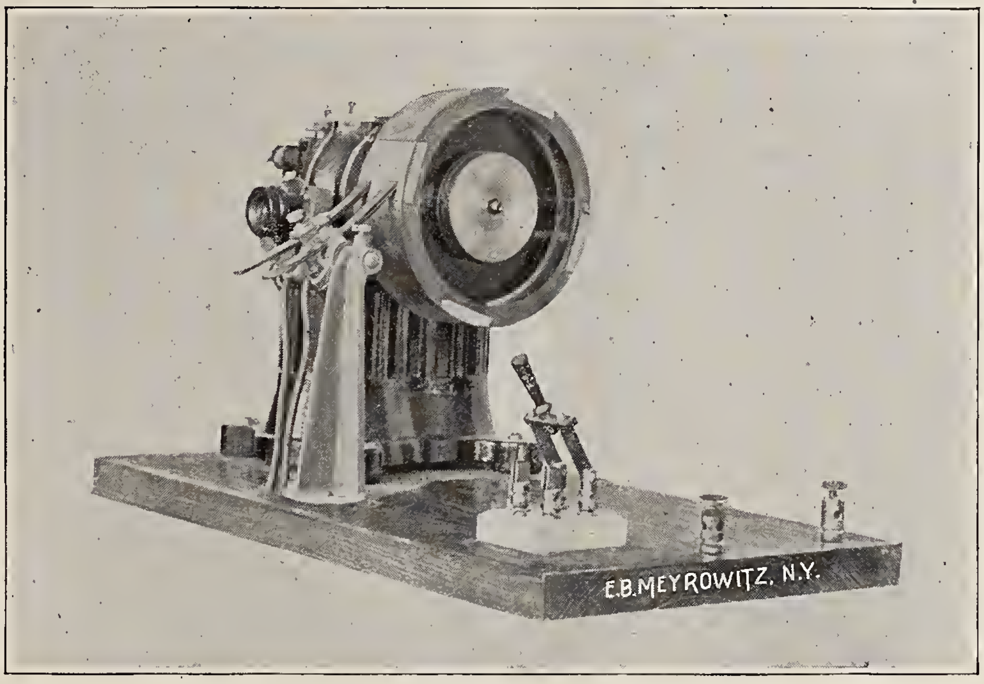
To prodnce these remarkable rays the following apparatus is required :

(1). A Crookes tube.
(2). Ruhmkorff induction coil.
(3). Edison fluoroscope or fluorescent screen.

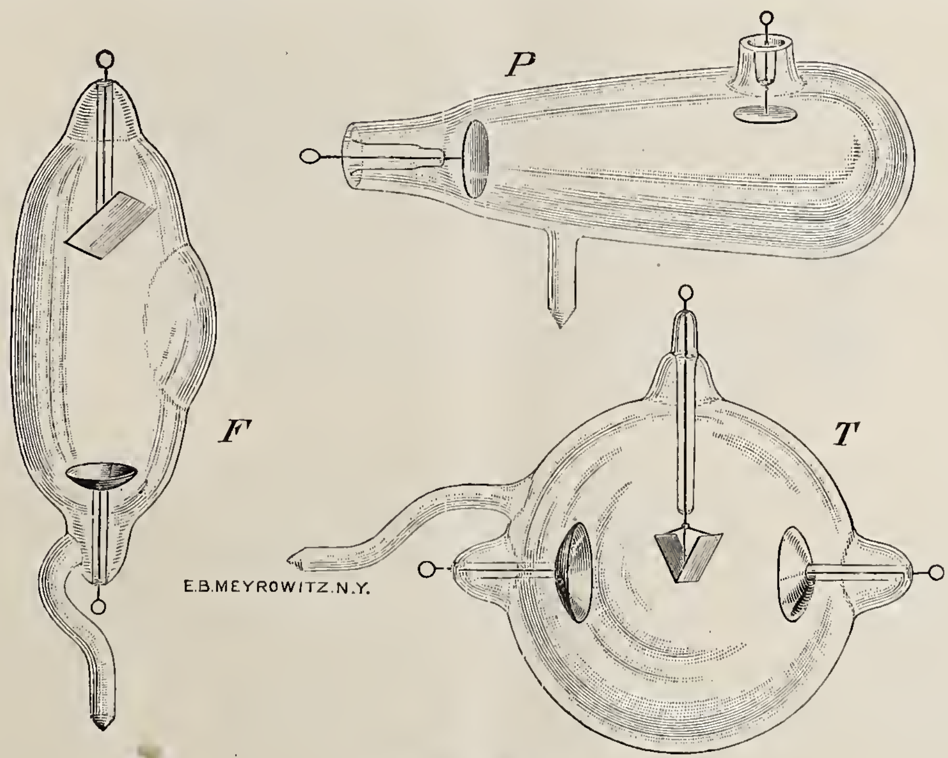
DR. WM. J. MORTON TAKING X-RAY PICTURES IN HIS LABORATORY.

(4). A source of electric current.

The Crookes Tubes which are used to generate these rays are so named after Sir William Crookes, F.R.S., who constructed them for his famous experiments in radiant matter. In these tubes the air has been exhausted to such a degree that the remaining particles have a vastly greater freedom of movement than when under usual atmospheric pressure. Under these circumstances, on leading a powerful electric force into the tube by means of its sealed-in electrodes, these air particles are thrust to and fro between one of the electrodes and the glass opposite, just as an electric machine causes pith-balls to dance, and by their incessant bombardment cause heat to appear in both metal and glass and also the glass to phosphoresce. It is from the phosphorescent spot on the glass that the X-rays emanate.



CONTACT BREAKER.



CROOKES TUBES.

FLUOROSCOPE.

X-RAY PHOTO OF HAND.

These tubes are made in various shapes—globular, pear-shaped (fig. P) and cylindrical (fig F). The most efficient and latest improvement in this line is the focus tube (fig. F), so called on account of the peculiar construction of the electrodes. The concave electrode is always to be used as the cathode. The cathode rays proceeding from it focus on the platinum sheet, which forms the anode, sending off from the spot on which they focus a powerful stream of X-rays. As this spot is quite small, radiographs made with this tube are always well-defined and may be made in a much shorter time than would have been considered possible at an earlier period.

Fig. T represents a Thompson double focus tube having two cathode electrodes, the rays from which are projected simultaneously against the V-shaped anodes placed between them, and give a very brilliant fluorescence.

The Induction Coils used are commonly known as the Ruhmkorff coil, being named after Ruhmkorff of Paris, who, though not the inventor of the same, made many instruments of the kind, and contrived various improvements. One of the most important factors in the production of the X-ray is a perfect working induction coil, as upon its action depends the satisfactory fluorescence of the vacuum tube. The efficiency of the coil depends principally upon the *insulation of the secondary*, which is the most vital part of the coil, a break in this section rendering it practically useless. To overcome any possibility of internal sparking into the primary, or a tendency to spark from the coil to outside objects, a special insulating material is used in the winding of the coil. The base of the coil contains a condenser suitable to the sparking capacity of the coil, and a disconnecting switch and pole-changer.

The make and break apparatus is designed to take the place of the vibrator of the coil, and by reason of its rapid revolutions, produce as nearly a continuous fluorescence as it is possible to make. With it the finest results are obtained, both in radiography and fluoroscopic exhibitions, and it should be employed on all coils of over 5-inch spark, as it reduces the wear on the coil to an appreciable extent, and is much more satisfactory than the vibrator for continuous service. The wheel is made of solid brass with four slate interruptions; the brushes are set on an independent arm and can be adjusted over the surface of the wheel so that it will not wear in one place.

The motor operating the wheel is adjustable to two speeds, and can be regulated to give the best results with the current used.

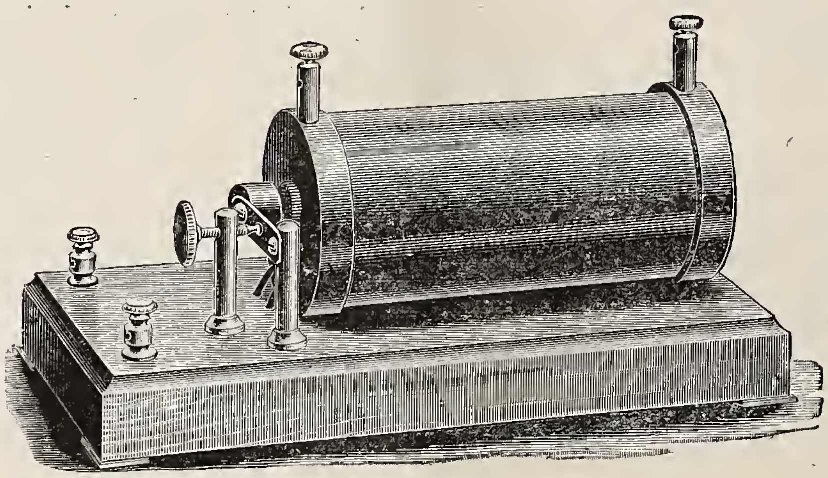
The entire apparatus is mounted on a polished oak base, and separate switches are provided so that the motor may be started first and obtain headway before turning the current into the brushes and coil.

The Fluoroscope designed by Mr. Edison consists of a flaring box, curved at one end to fit over the forehead and eyes like a stereoscope. The end of the box is closed by a pasteboard cover, on the inside of which is spread a layer of tungstate of calcium, which material Mr. Edison reports he has found to possess six times the fluorescing power under the influence of the X-rays, as compared with barium platino-cyanide.

By placing the object to be observed, such as the hand, between the vacuum tube and the fluorescent screen, the shadow is formed on the latter and can be observed at leisure.

The fluorescent screens are made for use in public exhibitions, as they permit more than one person to observe the X-ray picture at the same time in a darkened room. They are mounted in wooden frames with protecting glass over the tungstate of calcium, and can be either stood upon a table or suspended before the tube. The materials are the same as those used in the fluoroscope.

As has been previously stated, various methods of generating the electric current for the production of the X-rays may be employed, namely: primary batteries, storage batteries, or the direct incandescent current, each working equally satisfactory, but requiring more or less accessory apparatus to add to their general efficiency. The least expensive form is to use primary batteries, and any good set of cells giving the voltage required to operate the coil will answer, although we would recommend the Edison-Laland battery, type S, eight cells of which give about 5.3 volts, the average voltage required by 4 to 6-inch coils.



RUHMKORFF COIL.

With these cells, the outfit consists simply of the tube, coil, fluoroscope or screen, and batteries, the electromotive force of the cells making it safe to use the vibrator of the coil without injury or detriment to the same, while the single condenser in the base of the coil has sufficient microfarad capacity to give a good fluorescence; a more steady discharge is obtained by the employment of an additional adjustable multiple condenser of at least 2.5 microfarads.

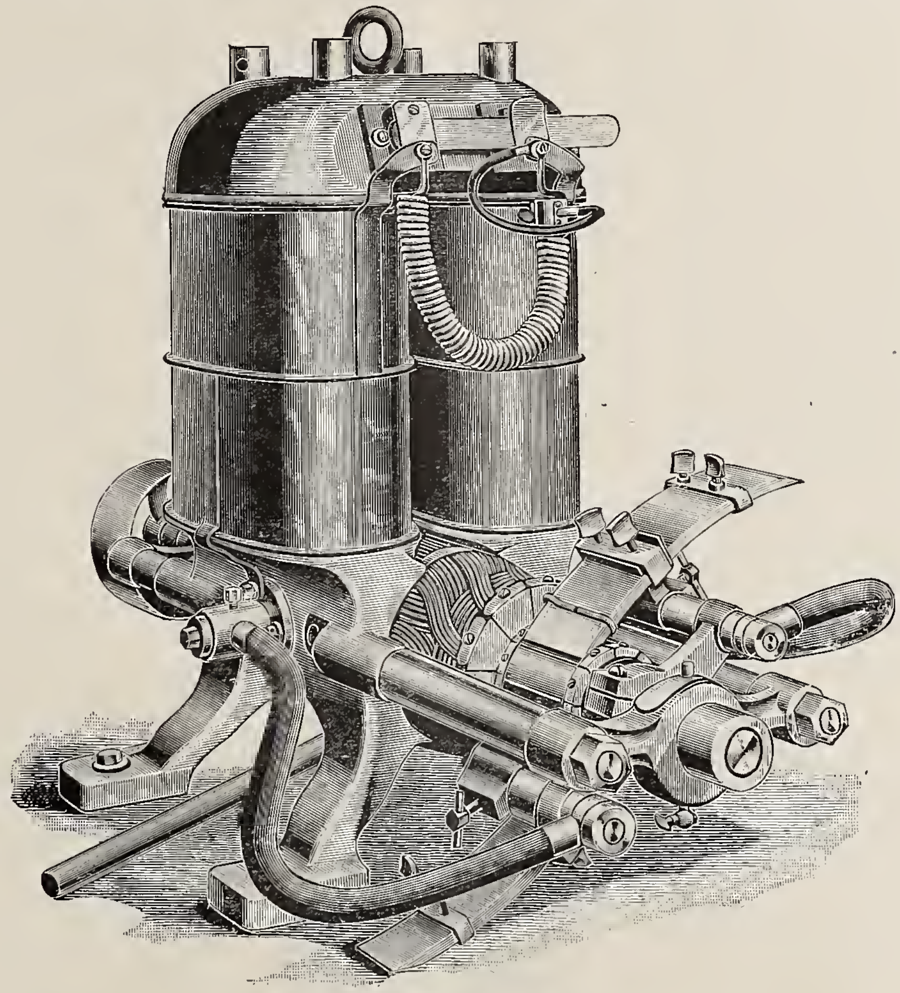
Similar results are obtained by four storage cells, giving eight volts, the difference between the two types of batteries being that the storage cells can be kept operative by being recharged at stated periods at any electric light station, while in the primary cells, the entire elements are consumed and have to be replaced. The use of storage cells also permit the employment of a make and break wheel operated by a motor, which takes the place of the vibrator on the coil, and reduces the wear to a maximum and gives the most perfect fluorescence in the tube. Two additional storage cells are required to operate the motor.

A very excellent volume on the subject of X-rays, written by Dr. Morton, as well as an outfit as described, can be obtained of E. B. Meyrowitz, optician, 104 East 23d Street, N. Y.

THE WORLD DYNAMO.

The World dynamo is the invention of Mr. Herman Boissier, general manager and electrician of the Arnoux & Hochhausen Electric Company, Nos. 478 and 480 Pearl street, New York. The main features of this plater are high efficiency, absence of heat and perfect regulation. It is shunt-wound and carefully protected and insulated. For electrotypers' use this machine cannot be equalled; it has large bearings, an automatic oiler and a great commutator surface. It produces a good shell of

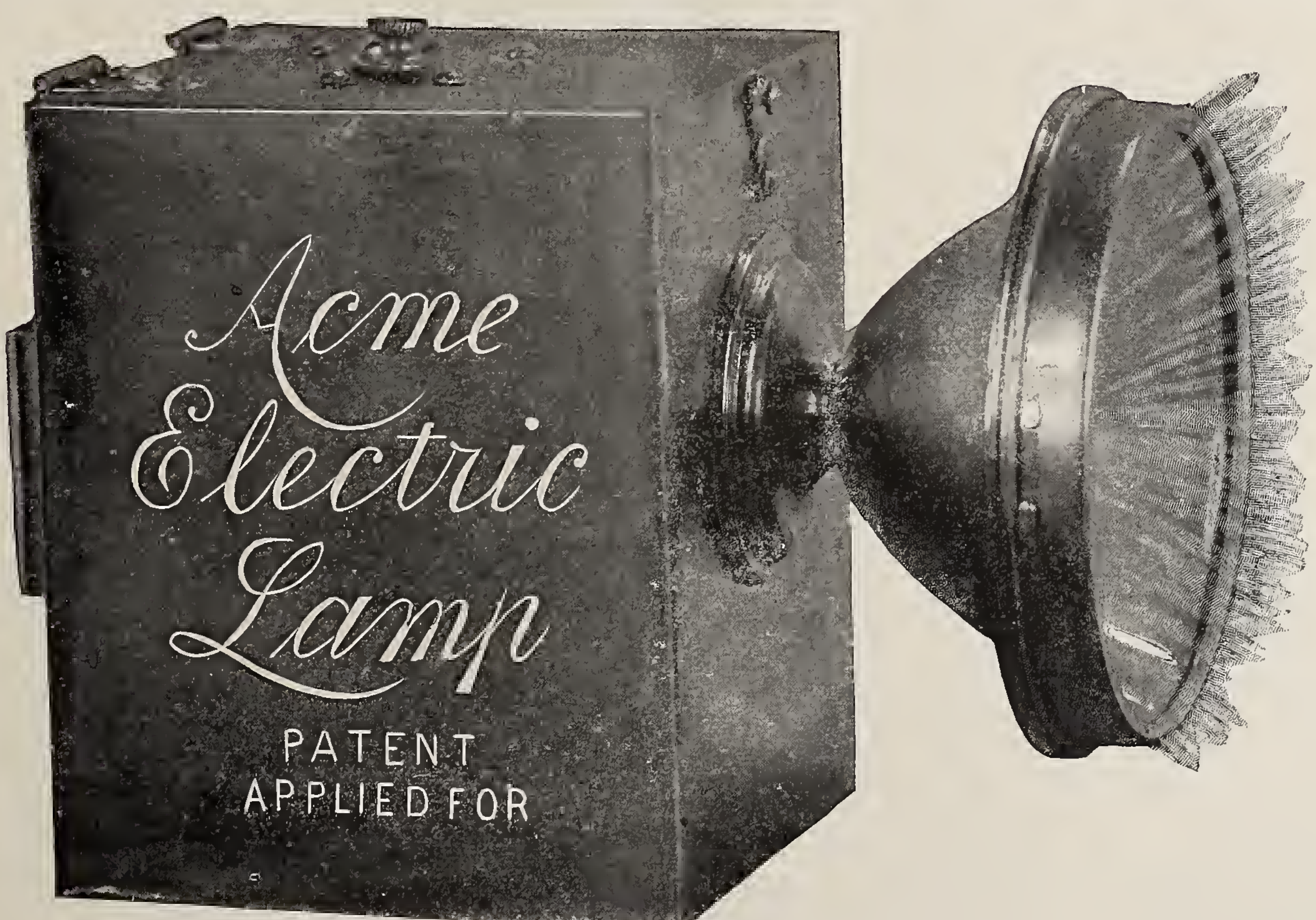
metal in one-half hour. This machine is the result of Mr. Boissier's ideas and represents the product of 16 years' experience in this particular department of electricity.



THE WORLD DYNAMO.

THE ACME ELECTRIC BICYCLE LAMP.

The problem of a perfect bicycle lamp has been solved and the oil lantern has been relegated to the past. It is not necessary to allude to the many disadvantages to the rider who uses oil, naphtha, taper, or any form of liquid electric light; they are too apparent and familiar to be recounted here, and the mere fact that the riding public is now offered an electric light that no jar or concussion will extinguish, from which no heat or odors arise, and does not contain a chemical to injure the most delicate fabric, or in other words is aboslutely dry, which can be controlled without dismounting, that is so simple in its construction that a knowledge of electricity is not required, and which is guaranteed for eight, and, with economical use, will last for ten hours, needs no further comment to commend it. He who would expect more seeks the impossible, and "the light that never fails" is not for him. Call on the Acme Electric Lamp Co., No. 1659 Broadway, between 51st and 52d streets, and see the best made.



ACME BICYCLE LAMP.

YALE & TOWNE'S CHAIN BLOCKS.

The usefulness of a chain block is almost too well known to need further mention. Because of their value to machine shops and all places where heavy objects are to be moved, certain types have been put upon the market of suitable design, constructed with the object of meeting special circumstances successfully. As we obtain leverage by means of a long arm resting on a fulcrum, so likewise do we gain by the use of a rope or chain device in which this principle of supplying speed for power is kept in view. This point is given expression to by the word "velocity-ratio." It determines the differences between chain blocks by establishing a ratio between the number of feet of chain required to lift the weight one foot in one block and another.

The Yale & Towne people have treated this subject in a scientific manner and obtained results that are of great commercial value; so great, in fact, that chain blocks made by them are correct in every detail and of high efficiency. "The triplex block" shown in the cut obtains its power through a train of spur gearing, and hence has a higher efficiency than any other similar device invented.

By writing to the general offices of the Yale & Towne Manufacturing Co., No. 280 Broadway, New York, catalogues and prices can be obtained and the attention of a firm willing and anxious to please.

YALE WESTON TRIPLEX BLOCK.

SILVER TURNED INTO GOLD.

Dr. Stephen H. Emmens, of New York City, announces that he has discovered a process by which he can transmute silver into gold. "Gold," said he, "is universally believed to be practically indissoluble, but we have found a way to dissolve it, as sugar dissolves in water. I cannot make public now the processes which we propose to employ. We already see our way to practical success. We have discovered a satisfactory method of varying molecular density, and what remains to be done is to control the time factor of the process. By reducing the time we shall reduce the expense of the transmutation, and when it is considered that a cost of even $10 an ounce will leave an enormous profit, it will be seen that we have ample margin at our disposal. There is, accordingly, a serious probability of silver becoming marketable at a greatly enhanced price. When it is known to be in reality a form of gold, or, rather, a raw material from which gold can be produced, its intrinsic value will be that of gold, after allowance is made for the cost of conversion and for such profit as the patentees of the process may consider reasonable."

"But you will spoil a political issue if you succeed," interrupted a New York "Press" reported, inadvertently.

"Oh, yes," said Dr. Emmens, indifferently. "This discovery is a feature that the ardent political combatants of the day may have to take into account. Othello's occupation will be gone, indeed, if the rivalry between gold and silver should disappear. The success of our efforts will mean a permanent settlement of the great question of 'gold versus silver.'"

The Soldering of Glass.—Margot has been making some very interesting investigations upon the subject of the soldering of glass, and has established the fact that an alloy composed of 95 parts of tin and 5 parts of zinc will melt at 200° C., becoming firmly adherent to the glass, is unalterable, and exhibits an attractive metallic luster. An alloy containing 90 parts of tin and 10 parts of aluminium will melt at 390° C., and also forms a very strong solder for glass, being likewise possessed of a very stable brilliancy. With these two alloys always ready to hand, we may claim to have discovered a means of soldering glass as easily as soldering any two pieces of metal, and the operation is easily performed. When the glass is heated in a furnace the soldering can be accomplished by rubbing the surface with a rod of either of the above named solders. The alloy as it flows can be evenly distributed with a tampoon of paper or a strip of aluminium, or with an ordinary soldering iron.—Invention.

POSSIBLE CONTRACTS.

New York City.—William B. Franke, of No. 217 West 125th street, is building two 7-story fireproof apartment houses, to cost $150,000, at the northeast corner of West End avenue and 79th street.

Trenton, N. J.—A syndicate of New York and Philadelphia capitalists has been formed to construct an electric railway between New York and Philadelphia. The capital stock of the New York & Philadelphia Traction Company is $10,000,000. There will be nearly one thousand miles of road connecting the principal towns of New Jersey. Work upon the new road is to be commenced in a few days. A contract has just been given out for operations between New Brunswick and Bound Brook and Raritan and Dunellen, which will amount to $475,000. A power house to cost $100,000 is to be erected near Bound Brook.

Brunswick, Ga.—The city is considering the granting of a new electric lighting franchise. Address the Mayor.

Frankfort, Ky.—The sinking fund commissioners of the State Penitentiary have decided to arrange for the erection of a large electric light plant.

Austin, Tex.—L. A. Ellis, W. R. Hanby, Edward Wilson and others have organized a company to build an electric line in the city.

Piedmont, W. Va.—The city contemplates erecting an electric light plant, and is now making investigations regarding it. J. P. Williams, Mayor.

Philadelphia, Pa.—Work has been started by Patrick O'Meara on a 5-story brick and iron light manufacturing building on the west side of 8th street, next to the south corner of Sansom street.——The Cathedral is to be illuminated with incandescent lamps. More than 700 will be distributed through the cathedral proper, in and about the dome, transept, nave and other portions of the interior. The parochial school will have 100 lights, as will also the Archbishop's residence; the convent will have 40 additional ones and the chapel 75. The illumination, it is said, will cost between $4,000 and $5,000.——Contractors R. S. Ballinger & Co. began to-day to make additions and alterations to the Heed Building, Nos. 1213 and 1215 Filbert street, to cost $21,000. The present structure is now six stories in height, and two additional stories are to be put on the building.——Charles L. Pierson will begin the erection of a store and two dwellings, a stable and a grain elevator at Broad and Huntington streets. The dwellings will cost $6,500 each; the elevator will cost $34,000. A. C. Wagner, architect, prepared the plans.

Norristown, Pa.—Mr. Bean is making plans for extensive alterations and additions to the Windsor Hotel, of this place, Samuel Minch proprietor. An electric light plant will be introduced and elevators constructed.

TELEPHONE NOTES.

Easton, Md.—The Union Telephone Company, of this place, M. M. Higgins, manager, wants bids on constructing its entire system (about 75 subscribers), with or without telephones, company to furnish poles and possibly telephones and switchboards.

Fulton, N. Y.—At the regular meeting of the Board of Trustees held Tuesday evening a franchise was granted John H. Drake and Geo. S. Stitch to place a telephone plant in the village. Work will commence as soon as they have 50 subscribers.

Chattanooga, Tenn.—A franchise for establishing a telephone system has been applied for by the People's Telephone Company of Knoxville, Tenn.

Auburn, N. Y.—A scheme is on foot to establish another telephone plant in Auburn. Representatives of out-of-town capitalists are expected to arrive early next week to look over the ground.

NEW CORPORATIONS.

Chicago, Ill.—Glen Ellyn & Lombard Electric Light & Power Company has been incorporated at Glen Ellyn. Capital stock, $20,000. Incorporators, Thomas Gibson, Joseph L. Gibson, and Charles F. McElroy.——United States Motor Company, incorporated, Chicago. Capital stock, $2,500; to manufacture motors. Incorporators, Charles E. Burnah, Horace E. Wells and M. A. Wells.

Kalamazoo, Mich.—The Kalamazoo Light, Heat & Power Company has been incorporated, with a capital stock of $200,000.

NEW TELEPHONE COMPANIES.

Webbville, Ky.—The Webbville & Blaine Telephone Company has been incorporated; B. F. Webb, president; J. W. Ratcliff, secretary, and F. H. Moore, treasurer. Capital stock, $600; to construct a telephone system.

Aiken, S.C.—The Carolina Telephone Exchange Company has been incorporated, with a capital stock of $10,000, to establish telephone systems in South Carolina. C. K. Henderson is president; James Powell, vice-president and secretary; and W. J. Platt, treasurer.

Chattanooga, Tenn.—An application was filed for a charter for the Chattanooga Telephone Company. The incorporators are: J. C. Duncan, Xen Wheeler, T. H. Payne, Thomas McDermott, D. P. Montague and W. I. Crandall. In the application for charter the incorporators state that it is their intention to establish a thoroughly equipped telephone system in that city.

Muskegon, Mich.—The Citizen's Telephone Company has been incorporated. Capital stock, $18,000.

Detroit, Mich.—The Detroit Telephone Construction Company has been incorporated with a capital stock of $250,000.

TELEPHONE PATENTS.

Issued July 21, 1896.

564,196. Telephone. Edmund A. Hinckley, Owego, N. Y. Filed Nov. 11, 1895.

564,328. Telephone Exchange System. William W. Dean, St. Louis, Mo. Filed April 10, 1896.

564,456. Operator's Keyboard Apparatus and Circuit Therefor. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Filed Sept. 28, 1893.

564,457. Operator's Keyboard Apparatus and Circuit Therefor. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Filed Jan. 10, 1894.

564,458. Keyboard Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Filed May 14, 1894.

Issued July 28, 1896.

564,745. Telephone System. Claude C. Gould, Philadelphia, Pa. Filed July 5, 1895.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued July 21, 1896.

564,182. Electric Igniter for Gas Engines. Louis M. Bourgeois, Jr., New Orleans, La. Filed June 7, 1895.

564,195. Electric Car Brake. John C. Henry, Colorado Springs, Colo. Filed July 15, 1895.

564,200. Alternating Current Dynamo. Maurice Hutin and Maurice Leblanc, Paris, France. Filed May 10, 1894. Patented in France Jan. 6, 1893; in England, June 24, 1893; in Belgium, June 27, 1893; in Switzerland, July 3, 1893; in Italy, Aug. 24, 1893, and in Spain, Feb. 9, 1894.

564,229. Automatic Fire Alarm System. Edwin A. Speer, Toledo, O. Filed May 3, 1895.
564,243. Rail Bond for Electric Railway. Fred H. Daniels, Worcester, Mass. Filed June 15, 1895.
564,262. Electrical Transportation System. Philip K. Stern, St. Louis, Mo. Filed Oct. 7, 1895.
564,283. Electric Switch. John T. Hunt, New York, N. Y. Filed May 12, 1896.
564,296. Magnetic Chuck. Oakley S. Walker, Worcester, Mass. Filed Feb. 13, 1896.
564,314. Anunciator. John B. Rogers, Zillah, Wash. Filed Oct. 31, 1894.
564,331. Electric Metal Working Apparatus. Hermann Lemp, Lynn, Mass. Filed June 15, 1891.
564,333. Means for Generating Electricity from Car-Wheel Axles. Morris Moskowitz, Newark, N. J. Filed Nov. 1, 1895.
564,334. Means for Generating Electricity from Car Wheels. Morris Moskowitz, Newark, N. J. Filed Mar. 14, 1896.
564,335. Means for Generating Electricity from Car-Wheel Axles. Morris Moskowitz, Newark, N. J. Filed Mar. 14, 1896.
564,336. Means for Generating Electricity from Car-Wheel Axles. Morris Moskowitz, Newark, N. J. Filed April 23, 1896.
564,344. Electric Signal Apparatus for Elevators. Samuel C. Stickle, New York, N. Y. Filed Aug. 4, 1894.
564,369. Elevated Electric Railway. Edward W. Farnham, La Grange, Ill. Filed Oct. 14, 1892.
564,395. Electric Car Trolley. William H. Russell, Newcastle, Can. Filed Oct. 31, 1895.
564,437. Electric Blasting Machine. James Macbeth, Brooklyn, N. Y. Filed Oct. 31, 1895.
564,453. Electric Metal-Working Apparatus. Elias E. Ries, Baltimore, Md. Filed May 1, 1891.
564,455. Electric Motor. Gordon J. Scott, Philadelphia, Pa. Filed Sept. 19, 1895.
564,480. Electric Elevator. George T. Francis, Chicago, Ill. Filed April 20, 1896.
564,485. Electric Mat. Oliver H. Hicks, Chicago, Ill. Filed Nov. 29, 1895.
564,527. Conduit Outlet Box for Electric Wires. Charles A. Mezger, Brooklyn, N. Y. Filed Jan. 25, 1896.
564,533. Emergency Car Brake and Fender. Charles C. Peck, Middlebury, Vt. Filed Sept. 17, 1895.
564,558. Speed Regulators for Electric Motors. Rudolph Eickemeyer, Yonkers, N. Y. Filed Oct. 6, 1891.
564,559. Dynamo-Electric Machine. Rudolph Eickemeyer, Yonkers, N. Y. Filed Oct. 7, 1891.
564,567. Thermostat. Hosea F. Maxim, Norfolk, Va. Filed Sept. 9, 1895.

New York Notes.

B. W. Payne & Sons, No. 41 Dey street, sold to the U. S. Projectile Company, of South Brooklyn, two 100-HP. direct-connected engines, C. & W. system; one 50-HP. direct-connected to card dynamo, to the Manhattan Rubber Co., of Passaic, N. J. This engine was run at the exhibition and attracted much attention on account of its oiling device and new governor. Two direct-connected engines with General Electric dynamos to George Cressan Company, of Philadelphia, Pa. One 100-HP. direct-connected to C. & C. Electric Company's dynamo of 50-K.-W. for use in Philadelphia. The Philadelphia office have received these orders. Over 15 engines have been sold since May 25, and they are exporting more.

Wm. B. Vandewater, assistant to the general manager of the Interior Conduit & Insulation Company, No. 527 W. 34th street, New York, after a year's close attention to business has been granted a two-weeks' leave of absence. Mr. Vandewater is stopping at Richfield Springs.

Frank Harrington, of the Habishaw Wire Company, has returned to business after a three weeks' vacation. His friends will not know him, he looks so robust and well.

Elmer P. Morris, of the Monarch Paint Company, has just returned from a big Western trip. He is now located at No. 36 Dey street, New York. His friends are welcome; a bottle of paint always open.

Fred Noll, the city representative of the Interior Conduit & Insulation Company, is one of the hardest workers in the trade. He sold 50% of their fan motors this season, the number running up into the thousands. Mr. Noll is one of the most popular men in the trade.

Frank de Ronde, the general manager of the Standard Paint Company, can always be found at his post. He is a very persistent worker and deserves the greatest credit for his efforts in building up the business of this company. He has created the demand for their P. & B. compound among all the leading manufacturers, supply houses, dynamo builders, etc. An armature varnish, greatly used, is of his own composition.

John Hunt, of Zwidars & Hunt, No. 127 5th avenue, New York, the well-known electrical contractors, has recently returned after a trip to Canada.

Jack Hatzel, of Hatzel & Buehler, electrical contractors, No. 114 5th avenue, New York, was elected president of the Electrical Contractors' Association last week. His partner has just returned from a pleasant vacation.

J. E. Keelyn, president and general manager of the Western Telephone Construction Co., of Chicago, will be at the Astor House August 24th next. He will close up some large contracts in the east and arrange for some extended business.

W. T. H.

The Electrical Age.

VOL. XVIII., No. 9. NEW YORK, AUGUST 29, 1896. WHOLE No. 485

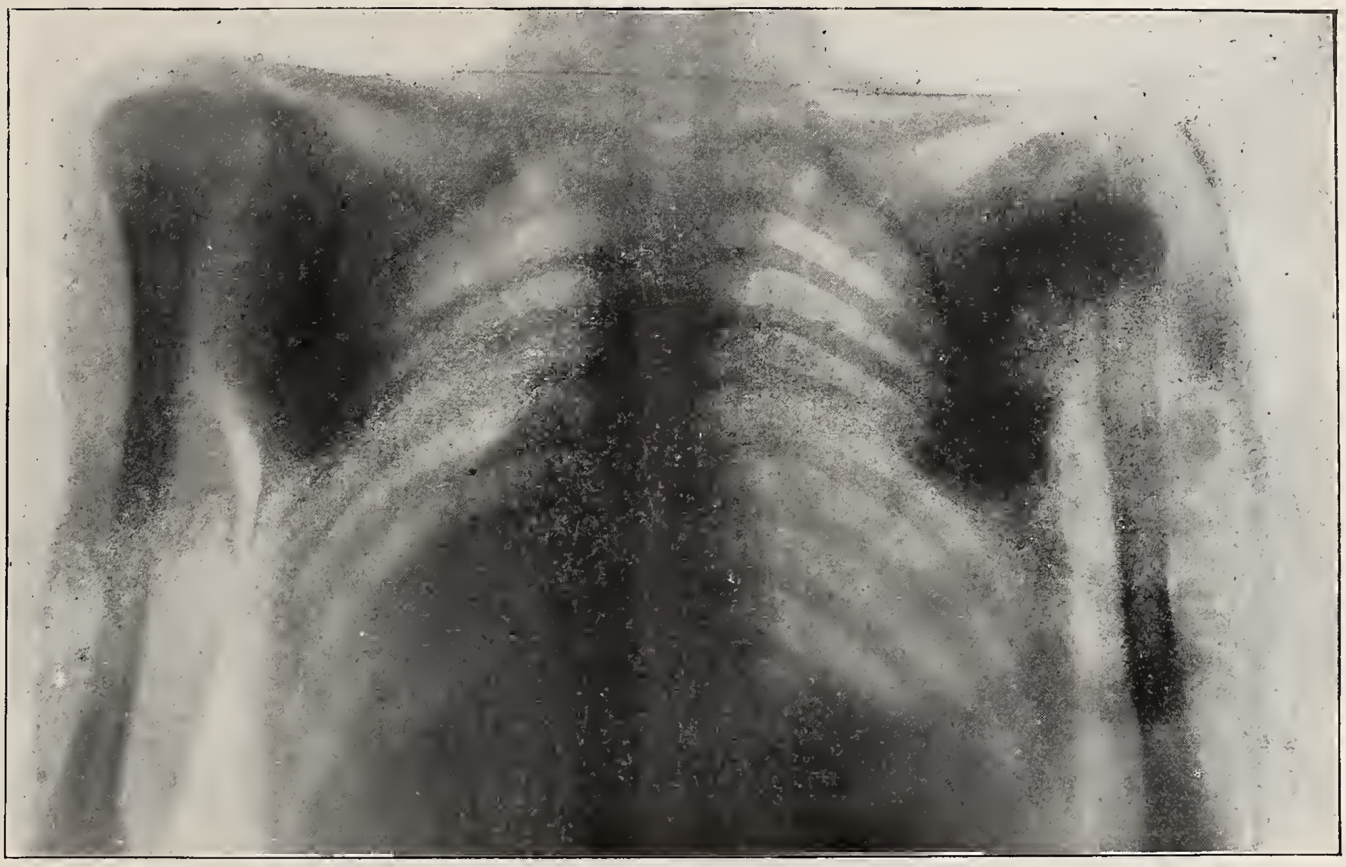


FIG. 73.

FIG. 63.

THE APPLICATION OF ROENTGEN RAYS.

Some remarkable photographs of diseased and fractured parts of the human body have been obtained by Dr. Morton with his X-ray apparatus. The descriptions under each picture tally with the reproduced photographs. They will undoubtedly be of great diagnostic interest to medical practitioners, as the new use of X-rays has proven its immense value in all such cases. It has supplied the physician with new eyes and a greater confidence. The

present exactitude of surgical operations will be so furthered that the knife and an X-ray outfit will go hand in hand. Dr. Morton has spent a great deal of time in finding out their application to medicine and the following cuts represent a few of his efforts in that direction.

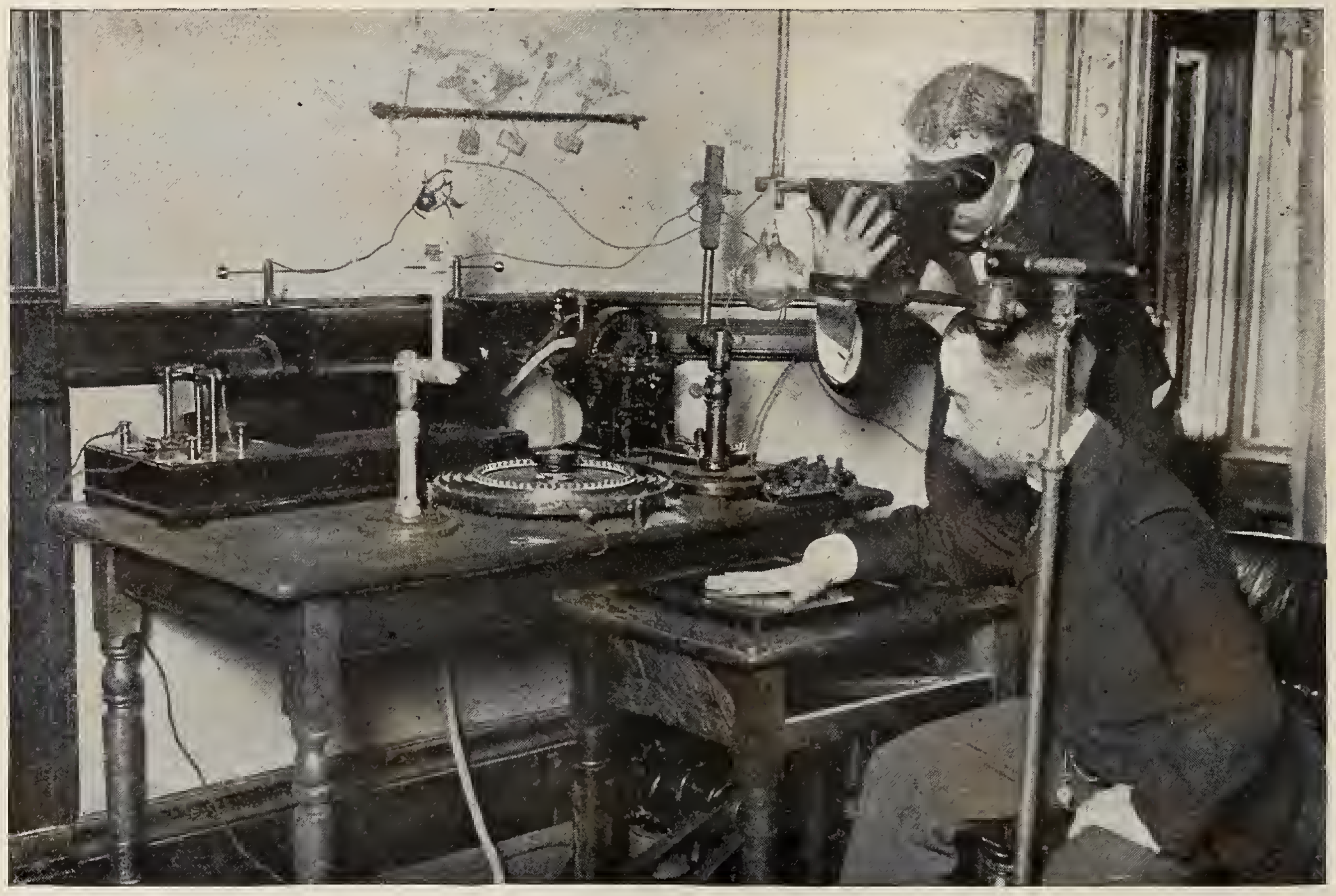


FIG. 54.

Fig. 69, X-ray picture of hands, showing a Colles fracture. The subject was a young girl, 16 years of age, who fell on the ice last winter, and the photograph shows that the bone of the arm telescoped into the head of the same bone. The doctor, who had this picture taken by Dr. Morton, stated that it changed entirely his diagnosis of the case, and that his operation would be altogether different from what he had intended.

Fig. 73 shows the full trunk of a boy, 14 years of age, who suffered from tuberculosis in the right shoulder. The X-ray picture shows that the shoulder joint had been eaten away, by making a comparison with the left shoulder, which is perfect and normal. This boy was brought to Dr. Morton's laboratory from Dallas, Texas.

Fig. 63 shows the bones in a man's foot, taken through the boot. The outline of the flesh and leather is distinctly shown; iron pegs and fasteners of the shoe are especially prominent, while the joints in the bones of the foot are very clear. This is a specially fine X-ray picture.

FIG. 55.

Fig. 55 shows Dr. Morton's hand, and was taken by him with an exposure of 32 seconds.

Fig. 54 is an ordinary photograph of Dr. Morton's X-ray laboratory, which has been pronounced by experts the finest in this country. Dr. Morton is looking at the bones in his hand through the fluoroscope, while Mr. Hammer

is having an X-ray picture taken of his hand without removing the slide from the dry plate.

X-RAYS USED ON ANIMALS.

Although the excitement caused by the discovery of the X-ray has in a great measure abated, experiments are being quietly prosecuted in many laboratories with a view to widening the range of utility already suggested by Professor Roentgen's discovery.

In one new experiment in Germany the human body was subjected to the action of the rays through an apparatus of special design, which enabled spectators to clearly observe the action of the diaphragm, heart and stomach. Another interesting demonstration was made in England, where the Roentgen rays were applied to animals without anaesthetics, more particularly for diagnostic purposes. Where radiographs of living animals are ordinarily taken the subject has to be kept still, either forcibly or by anaesthetics, but in this case the animals were moving when the pictures were taken.

The first application of the rays was made to two horses' knees, one of which was broken kneed. Two excellent radiographs were obtained, which clearly showed the difference in the two cases. These results promise to be of great service to the veterinary surgeon, as such an application of the X-ray to moving objects promises to do away with the extreme tediousness and difficulty of keeping the subjects perfectly quiet during the prolonged exposure.

Although in this instance the horses moved freely about during the time they were radiographed, the lines of the picture were perfectly sharp. The scientist who conducted the experiment says that, although he would scarcely yet undertake to successfully radiograph a vicious horse galloping round a paddock, he will guarantee that the spinal column of a circus horse as it trots around the arena can be distinctly reproduced in an X-ray picture.

It is proposed by the application of this system to make a series of radiographs of the wild animals at the London Zoo. The special apparatus required will, it is expected, be placed on the market by a leading firm of scientific instrument makers in London, at an early date.—N. Y. Journal.

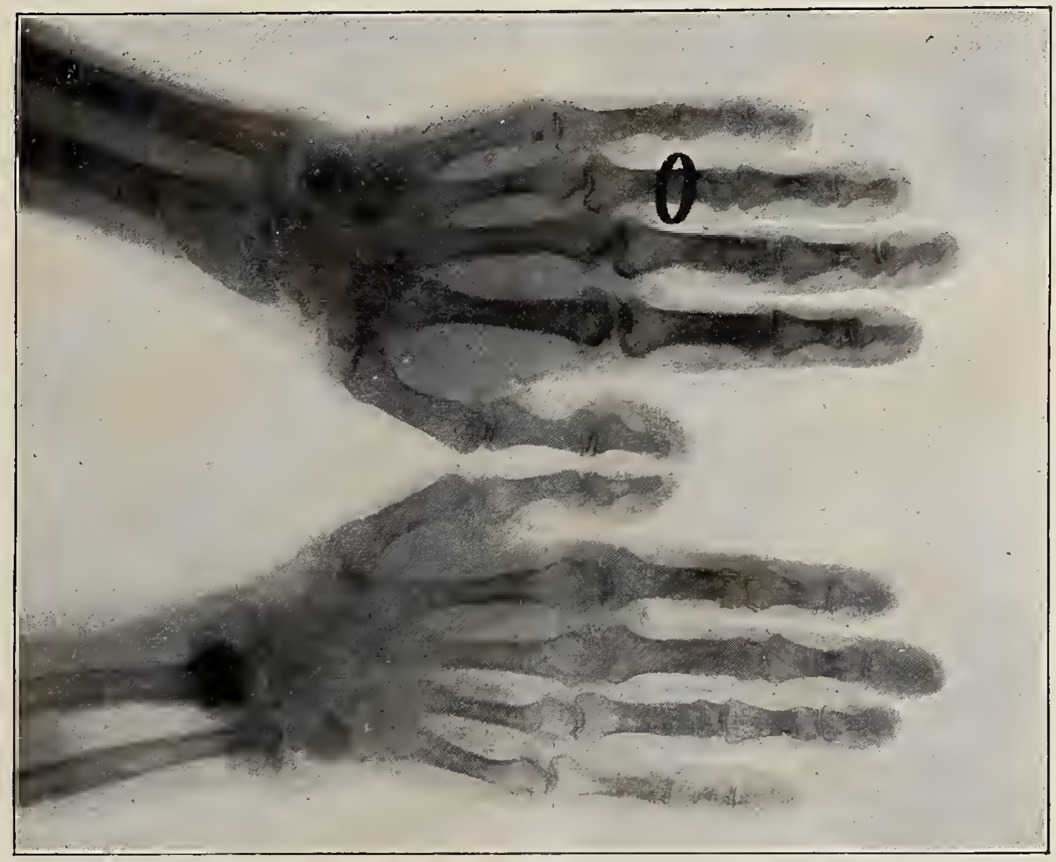


FIG. 69.

A DAY WITH SILEX.

To say that silex constitutes five-eighths of the crust of the earth might convey a correct idea to a mathematician, but it would fall far short of sending into the public mind any comprehension of the multitude of purposes for which both art and nature use it, and the one transcendent service which it is about to render. Let us in a plain and homely fashion first describe what silex is.

It is a white rock, of which there exists large beds scattered here and there throughout the earth; some of it chemically pure, all of it nearly so. We refer now strictly to these white beds of silex. This material is the most abundant substance in nature, is found in an impure state (mingled with other materials), wherever we can look or touch. It is a part of granite and of almost every other stone; a component part of asbestos, a stone that looks more unlike it than any other. The opal is composed of silex and water. Silex exists also in clay.

It is used to fill the grain of wood preparatory to varnishing; is used in paint; the glaze on our crockery is silex with an alkali added. Glass is mostly silex; it is an essential constituent of porcelain; it forms part of the stalk of the waving grain, and gives it its power to stand upright. The potter and the painter have long known of it as a characteristic and separate material. The scientist has known of it in a general way, as forming an essential constituent of most rocky substances. This is the extent of the popular knowledge of silex. Although there is more of it in this planet than there is on it of water, it has been to the public almost an unknown thing; probably because it is not so apparent to the senses as water. In the absence of silex we would quickly learn, and with a vengeance, what it is, how universally present it is, and how impossible it would be to get along without it. If silex were taken away, all the glass in our windows or elsewhere would disappear, the crockery upon our tables would vanish, the porcelain articles used for utensils in our kitchens, toilet and bathrooms, even the brick and stone of the walls of our houses, would crumble and fall in ruinous masses. No building composed of stone would stand an hour. The growing crops would fall flat upon the ground. The earth itself, its backbone and strength gone, would be disintegrated and fall asunder into its separate atoms. Without water, without light, without air, the earth might remain and preserve its apparent integ-

rity; but without silex it would crumble to pieces. So essential is silex, not only to the necessities and conveniences of civilization, but also to the very structure of the world. The lack of knowledge on this subject is in extraordinary contrast with the general information and intelligence of the times. Is it not reasonable to expect that upon a subject of this importance information will be welcomed?

Silex is the highest insulator of the electric current. There are these differences between it and other insulators, as for instance, India rubber, gutta percha, bitumen, paraffine. It cannot be set fire to and burned up. They can. It does not to the smallest amount lose anything whatever of its insulating power, either by the lapse of time of by the passage of the electric current, along the wire which it encloses. They do. They commence with an insulating power, which they steadily lose, and give no warning when they can no longer protect you from the danger of the live wire. We have said that silex would not burn up. It might have the quality of not being itself inflammable, and yet it might conduct heat. As a matter of fact, it is as high a non-conductor of heat as it is of electricity.

This highly interesting substance is used for the insulation of wires by the Silex Insulation Company, No. 39-41 Cortlandt street, New York. It is a treat to call on them.

TELEPHONE STUDY.

The Imperial Diet of Japan last February voted to expend $12,800,000 within the next seven years for the improvement of the government telephone system, and a young electrical engineer named Rinja Nakayama was sent to the United States for the purpose of investigating the latest inventions and improvements along that line.

Speaking of his work in this country for the past three months he said: "Five Japanese cities, Tokio, Osaka, Kyato, Kobe, and Yokohama, are already supplied with telephone systems controlled by the government. The telephone department is one of the five branches of the Imperial Department of Communication. The other four branches are the railway, telegraph, postoffice and navigation. The telephone was first introduced into Japan in 1890, but little attention was paid to it, because of the Chinese war. Last February the Imperial Diet of Japan took the matter up and a generous appropriation followed. The government now proposes to extend the system throughout the whole empire. My visit to this country is to gather information in regard to the minor details of the telephone. I have spent three months in the West and will stay a similar period in the East, after which I will sail from New York for Europe, and visit the great continental cities."—Buffalo Commercial.

A French technical journal announces a new invention in the field of electrical metallurgy. It is a process which will give an extraordinary hardness to steel. It is reported that the inventor, a Mr. Taux, has executed the following experiments before a committee of engineers at Strasburg: A drill hardened by electricity pierced a shell twice as quickly as a drill of the best steel hardened in the ordinary way. The drill was closely examined afterward by means of a strong microscope, and not the least injury could be discovered. An electrically-hardened circular saw cut iron bars with surprising ease. With a cold chisel similarly treated a steel bar, one by one-half inch, was cut through, and the operation was repeated five times on the same bar. Then a cast-steel plate, one-fourth of an inch thick, was cut with the chisel, the edge of which showed neither a fissure nor any other alteration afterward. An electrically-hardened table knife cut iron wire of one-eighth of an inch diameter just as easy as a cotton string. The process is said to consist in the hardening of the red-hot steel objects in a conductive bath traversed by an electrical current. If these tests should be confirmed by further practical experience, the consequences would be of the greatest importance for the manufacture of tools.—N.Y. Commercial Advertiser.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—CLEANSING OF BOILERS.

Baltimore, Aug. 22, 1896.

To the Editor.

Dear Sir:—Can a steam boiler be cleaned by any electrical means. If so, is it practical to use in a large steam plant? Yours truly, F. L. Lang.

(A.)—We know of no method of an electrical nature that will successfully clean boilers. Many have been suggested and tried without real success.

(Q.)—WINDMILL FOR DYNAMO.

Boston, Mass., Aug. 24, 1896.

Electrical Age Publishing Co.

Dear Editor:—I have believed that the wind might be directly used for the generation of a current by means of a windmill of the proper size. Has this ever been tried and, if so, with any success? Yours respectfully,

Cyrus Manner.

(A.)—Mr. Brush published an article in the "Scientific American" of some years ago descriptive of a windmill plant to be used for home lighting. The blades of the windmill were automatically regulated, and the dynamo likewise controlled for very low or high speeds. A storage battery plant was used. It was a success, and, we think, worth while repeating.

(Q.)—FLICKERING ARC LAMPS.

Philadelphia, Aug. 26, 1896.

Editor Electrical Age.

Dear Sir:—Your Inquiry Column has proven so beneficial th me that I will seek further information from it. I have several pairs of arcs burning on a 110-volt circuit, but in spite of all my care and adjustment, they flicker frightfully. Can you advise me in this matter?

Yours respectfully, Andrew B.

(A.)—Either poor carbons will cause a lamp to flicker and hiss, or a lack of sufficient pressure. If your carbons are good, cored Nuremburgs, your pressure is too low. Attend to these two details and let us know of the result. We presume that the mechanism is perfect, of course.

(Q.)—ELECTRIC HEATING.

Washington D. C., July 20, 1896.

Electrical Age Publishing Co:

Dear Sir:—I have been thinking of using electricity for cooking and heating, and would like to know through your Inquiry Column whether the plan is feasible or not. Also would be obliged to you on receipt of some figures pertaining to the same. Yours very truly

Albert R. Sloan.

(A.)—Electric heating is unequalled for cleanliness and convenience. It is slightly expensive for heating, but would pay if the two first are very desirable. It will surely become popular in time. Write to American Electric Heating Corporation, Barnes Building, Boston, Mass.

Incandescent Gas Light and Electric Light in Paris.—Fifteen large establishments at Paris have discarded electric lighting and installed 2,300 Auer lamps in its stead. Eight of the finest cafés, among which the famous Café de la Paix, on the Place de l'Opera, are using incandescent gas light together with electric light, while a great number of public houses on the boulevards will adopt the gas light as soon as the contracts of the owners with the electric light company have expired.—American Manufacturer.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 474.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

The study of the irregularities exhibited by the British candle suggested to one of the members of your committee that the use of a different criterion of the light emitted by a candle than that now employed, namely, rate of consumption of sperm, might lead to better results in their use. The method proposed is to measure at the time that the photometric setting is made, the height of the flame. Then, knowning the relation between flame—height and intensity of light emitted, to reduce the instantaneous intensity to intensity at standard height.

Two methods were employed to determine the ratio of the flame height to the intensity. In the first method the intensity of the radiation of the candle was measured by the bolometer in the way previously described. To measure the height of the flame, a long camera was constructed having its lens and ground-glass plate at a fixed distance from each other. The ground-glass plate was graduated empirically to read directly in millimeters the height of objects focussed upon it. The candle was placed on a pan attached to a spiral spring of such a length that its elongation would be just equal to the length of the candle. By this arrangement the top of the candle was kept at a constant height above the floor, and when once the image of the base of the flame had been accurately adjusted on one of the lines of the camera screen (to facilitate which the screen was capable of a slight vertical movement), it

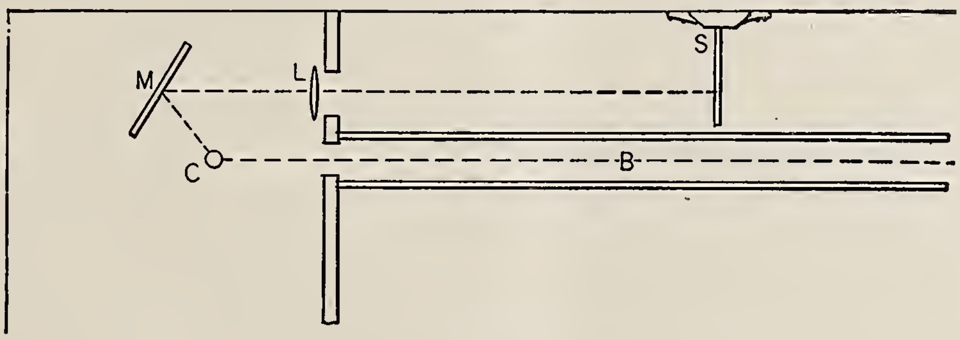


FIG. 4

TABLE III.

Flame height, mm.	Galvanometer deflection.	Flame height, mm.	Galvanometer deflection.	Flame height, mm.	Galvanometer deflection.
48.0	29.0	44.0	26.7	43.0	25.8
48.5	29.5	45.0	27.5	44.0	27.0
49.5	30.3	45.5	28.3	Wick of	candle
48.0	29.2	43.5	27.0	clea	ned.
47.0	28.2	43.5	27.0	55.0	37.2
47.5	28.8	44.5	27.5	46.5	30.6
45.5	27.5	44.5	27.5	47.5	31.3
46.5	28.0	45.0	28.3	48.0	32.0
46.5	28.2	44.5	27.7	49.0	32.7
46.5	28.0	43.5	26.5	49.0	32.6
45.0	27.0	43.5	27.0	49.5	32.8
45.5	27.6	43.0	26.5	50.5	33.7
45.5	27.8	42.5	26.0	50.0	33.0
44.5	26.5	43.5	26.8	50.0	33.0
42.0	25.8	42.5	25.5	50.0	33.2
43.0	26.8	43.5	26.0	49.0	32.6
43.0	26.0	44.0	26.3	47.0	30.4
43.5	26.7	43.5	26.0	48.5	30.0
44.0	26.8	43.5	26.2	48.5	31.0
44.5	27.1	44.0	26.7	47.0	31.0
44.5	27.2	44.5	27.0	46.5	31.0
43.5	26.4	44.0	26.8	46.5	31.0

TABLE IV.

Flame height, mm.	Photometer bar.	Flame height, mm.	Photometer bar.	Flame height, mm.	Photometer bar.
45.5	702	41.5	713	53.0	686
46.5	699	43.0	707	48.0	700
48.0	700	43.0	708	48.5	695
49.0	693	44.0	706	46.0	704
51.5	690	44.0	707	45.0	708
53.0	697	45.0	705	44.0	707
44.5	709	44.0	709	44.0	711
46.0	705	44.0	710	46.0	707
49.0	694	43.0	713	43.0	713
46.0	699	45.0	708	46.0	708
48.0	698	End of	wick	44.5	710
48.0	693	cut	off.	44.0	711
49.0	691	40.0	712	46.0	711
45.5	700	44.0	708	45.5	708
44.0	707	47.0	698	46.0	712
45.5	699	48.0	696	42.5	716
48.0	697	50.0	693	42.0	715
46.0	698	54.0	688	43.0	715
46.5	696	53.0	688	44.0	714
45.0	700	51.0	693	45.0	711
45.0	701	50.0	694		

remained there during a considerable period of time. Hence, to measure the height of the flame at any instant, it was necessary only to glance at the image on the *top* of the flame and to note its position on the screen.

The magnifying power employed was about two, and heights were measured only to 0.5 mm. Greater closeness of measurement was deemed unnecessary on account of the ill-defined nature of the base and tip of the flame. The actual base of a candle flame is difficult to observe, on account of the small quantity of light which it emits. The procedure adopted was to set on the line of demarkation between the charred and uncharred portions of the wick, since this was found usually to mark the base of the flame. In case a close inspection of the candle showed the base of the flame to be slightly above this point, a further adjustment of the screen was made.

In order to insure great steadiness of the flame, the candle was placed in a roomy, well ventilated box having a glass window. Having put the candle in position before the bolometer, and having adjusted the camera properly, the bolometer screen was raised, and simultaneous observations were made of galvanometer deflections and flame heights. These readings were corrected for any change in sensitiveness of the bolometer and any drift of the galvanometer needle, and were plotted, using flame heights and galvanometer deflections as co-ordinates.

In the second method, a Lummer-Brodhun photometer was used. At one end of a photometer bar 200 inches long was placed a 110-volt glow lamp. This was maintained at a voltage of 100 by means of a storage battery. Being run at a low efficiency its color was about the same as that of a candle, and its change in candle power during the time it was in use was too small to be detected.

At the other end of the bar was the candle, supported by its adjusted spring. The candle was always placed so that the curl of the wick was perpendicular to the axis of the bar.* The arrangement for measuring flame heights is shown in Fig. 4, which represents a projection of the apparatus on a horizontal plane. B is the photometer bar, C the candle, M a mirror placed behind the candle in such a way as to reflect the rays from it through the lens L, which projected them on a graduated screen, S, placed immediately behind the bar. The mirror was carried on a movable support, so as to admit of an adjustment of focus.

This arrangement was adopted, since by its use one observer could do all the work. The method was simply to make a rather quick photometer setting, and then instantly to note the position of the top of the flame on the screen, reading the position of the photometer afterwards.

The observations were treated in the following manner: The various observed values of flame height were collected in such a way that heights of 41.0 mm., and 41.5 mm., and 42.0 mm., formed one group; 42.5 mm., 43.0 mm., and 43.5 mm., another, etc. The mean height of each group was found, and also the mean bar-reading corresponding to it. The candle-power of the standard was found by taking the mean of all the heights and bar-readings, and reducing, by means of an approximate correction, to a standard height flame of 45 mm. Using this value for the intensity of the glow lamp, the intensity of the candle corresponding to each group was computed. By means of a curve plotted from these values, the percentage variation per millimeter of flame height was determined.

In order to find the relative accuracy of this, and of the ordinary method of using candles, the following observations were made: A candle burning normally was weighed by the "method of transits," was transferred to the spring balance, and ten or more photometer settings made—the flame height also being noted. The candle was then weighed again, and another group taken. A number of such sets of observations were made on several days, and since the glow lamp was used as a reference standard, these sets are comparable with each other.

The mean value of the candle-power of the glow lamp given by each of these sets of observations was corrected for rate in the ordinary way, and also corrected by reducing from the mean flame height to the standard height of 45 mm., using the mean value of the relation between intensity and flame height as determined from all the observations, both bolometric and photometric. The deviation of each value obtained for the candle-power of the glow lamp from the mean value obtained from all the observations was computed, and this deviation was reduced to percentages. A comparison of the percentage deviations given by the two methods shows their relative accuracy, while the absolute values of the percentages show the error which one is liable to make in using candles in either of the two ways. Table III. gives a characteristic set of data obtained by the use of the bolometer, 1894, March 21. Table IV. is a similar set of photometric data obtained 1895, Nov. 6.

(To be continued.)

POWER FROM SMALL MOUNTAIN STREAMS.

There is a growing tendency among the miners and exploiters of mines in the western part of the United States to utilize as motive power streams which not so very long ago would have been considered unworthy of consideration as sources of power. Men are beginning to learn that head counts as well as volume, and that a tiny stream with several hundred feet head may be as valuable a source of power as the more imposing fall of much lower head. Then, too, the little stream needs no expensive dam or head works to confine it, but can be trapped and guided at comparatively small expense, and instead of being allowed to fall freely, it can be led into a pipe which impounds it all, and thus it can be confined and led perhaps 500 to 1,000 feet down the mountain, accumulating pressure as it descends until it shoots out with full force against the buckets of the Pelton wheel, or quietly exerts its statical pressure in the chambers of a direct air compressor.

Not so very long ago the writer saw a plant being installed over 8,000 feet up in the Rocky Mountains, and the primitive pipe-making establishment was very interesting. Rather than incur the expense of hauling the wrought iron pipe, a small pair of bending rolls had been procured, and these, with a portable forge, constituted the equipment. Under a frame shed by the mountain side, three men were turning out length after length of riveted sheet-iron pipe, right at the place where it was to be used, and the pipe line was being constructed 500 feet up the canyon, bringing down over 2,000 horsepower to the spot where it was to be utilized. The operations seemed somewhat primitive at first sight, but the expense account of the establishment was a minimum, and when the cost of burro train and the railway freight, and the profits of several middlemen were taken into account, the miners were probably ahead in the long run.—From Cassier's Magazine for September.

NOTICE OF REMOVAL.

On and after Oct. 1, 1896, we shall be located in our new factory, at New Brunswick, N. J. With increased facilities in every way, including a larger factory better equipped, superior shipping facilities, etc., we shall be in a better position than ever to serve you promptly. The building is being erected especially for us, and will be equipped with all improvements. It is to be 200x50 feet, two stories and all brick. We hope to be settled there Oct. 1, possibly before. Asking for a continuance of your favors, which shall have as ever, our best attention, we are Yours very truly,

Beacon Lamp Company.

Harcourt street, Boston, Mass.

San Francisco, Cal.—The American Storage Battery Company has been incorporated by W. T. Bell, T. Z. Hardee, C. M. Massey, B. H. Bancroft and C. S. Preble. Capital stock, $25,000.

The Electrical Age.

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CONTENTS.

	PAGE
EDITORIALS	
The Limit of all Experiments	491
A New Light	491
GENERAL SUBJECTS	
The Application of Roentgen Rays	485
X-rays Used on Animals	487
Standards of Light	489
Transformers	492
Convention of the American Street Railway Association	493
Street Railway Convention of the State of New York	494
A Great Clam Bake	495
MISCELLANEOUS	
Telephone Study	488
Power from Small Mountain Streams	490
Working in Compressed Air	491
TRADE NOTES	
A Day with Silex	487
Possible Contracts	500
INQUIRY COLUMN	488

THE LIMIT OF ALL EXPERIMENTS.

This eminently practical world is awakening to the fact that its greatest savants are its hardest workers. It is beginning to understand that the laboratory is a workshop wherein some of the severest struggles between mind and matter daily occur. That the progress of some minds is meteoric is but too well known; that the outbursts of genius are the result at times of mental exertion laborious in the extreme and paralyzing in its prolonged effect upon the ardent investigator—that facts heap up but slowly in spite of determination and unsparing toil. What then is achieved if the atom of knowledge upturned is but the grain to the seashore? Shall we ever reach the limit of all experiments? In years that stretch forward to the vaults of infinity, the distance shall yet be as great. The Will o' the Wisp of fact will dance before the fevered brain and weave forever a web of fascination over mankind.

A NEW LIGHT

Below we publish a few facts that the "Journal" of the Franklin Institute republished in reference to Tesla's work. Our hopes are bound up in his efforts and every move that brings us nearer to the goal is a source of untold satisfaction to us all:

It is announced that Nikola Tesla has solved the problem which he set before himself many years ago, and which may revolutionize the system of electric lighting. It is, electrical experts say, the nearest perfect adaptation of the great force of nature to the use of man.

In Mr. Tesla's laboratory in Houston street is a bulb not more than three inches in length which, when the current is turned into it, becomes a bulb of light. The mat is almost imperceptible. With it a very large room is so lighted that it is possible to read in any corner. Yet this is done without the attachment necessary in existing lights.

The rays are so strong that the sharpest photographs may be taken by them. No new dynamo is required to produce the current. There is no danger of harmful shock in its use.

Stories have come from time to time from Mr. Tesla's laboratory that he was experimenting on a light of this sort. Rumors of success and failure have followed each other, and Mr. Tesla's friends were inclined to doubt that he would succeed. A half-dozen times the discovery was at his fingers' tips, only to elude him. But now he has told his friends of his success.

Mr. Tesla has been working for many years on his theory of the necessity and practicability of the conversion of electricity. The present incandescent light gives only 3% of illuminating power; the other 97% is wasted in heat.

In accordance with his theories, which have been already applied successfully to the economical transmission of the electric fluid, he applied himself to the saving of some of this wasted energy in electric light.

The bulb which he has perfected gives 10% of light and loses 90% of energy. Mr. Tesla declares that he will, with the aid of a few more experiments be able to produce 40% of light, so that the waste will be reduced to only 60%, or 37% less than at present.

The principle of the light is vibration. The illumination is secured by means of what Mr. Tesla terms a vibrator within a bulb, which holds the vibrating needle within a vacuum. The needle vibrates so rapidly that the figures per second sound imaginary, but it is this intensity of energy which gives the light its brilliancy and its apparent steadiness. The lights do not have to be renewed.—Ledger.

WORKING IN COMPRESSED AIR.

E. W. Moir, in a paper read before a recent meeting of the Society of Arts, gave some interesting data regarding the effects upon the human system of working in compressed air and the various practical means of lessening the danger and overcoming any sudden collapse. Mr. Moir had charge of the work on the Hudson River Tunnel for a time, and has had some connection with most of the underground tunneling ventures of the past two decades. He says: "When I first came to New York the men had been dying at the rate of one man per month out of forty-five or fifty men employed, a death-rate of about 25% per annum. With a view to improving this state of things, an air compartment like a boiler was made, in which the men could be treated homeopathically, or reimmersed in compressed air. It was erected near the top of the shaft, and when a man was overcome or paralyzed, as I have seen them often, completely unconscious, and unable to use their limbs, they were carried into the compartment, and the air pressure raised to about one-half or two-thirds of that in which they had been working, with immediate improvement. The pressure was then lowered at the very slow rate of one pound per minute, or even less, the time allowed for equalization being from twenty-five to thirty minutes, and, even in severe cases, the men went away quite cured. No man ever suffers by going into compressed air, unless his Eustachian tubes are blocked, in which case intense pain is produced, owing to the great difference in pressure between the two sides of the ear drum. The above-described lock should be used immediately on prostrations occurring, as it seems to be of little value after some time has elapsed. A very slight increase of carbonic oxide (if it much exceeds one part in a thousand) in the

compressed air chamber leads to increased sickness. The impurity never affects a man while below, but only after he comes out, and we had mules working under pressure in New York for over twelve months at a stretch, which sold at good figures after coming out. Every man should be medically examined, and hot coffee should be given to each man before he comes out of compressed air. A warm room to dress in and extra clothing for passage through the lock should be supplied. At the Blackwall Tunnel, with the experience gained and attention to the above points, we have not had a single death, notwithstanding the fact that we had men working under a pressure of thirty-seven pounds per square inch for some time. Generally sparely built men, not too full-blooded, are those who stand air pressure best. A man with weak lungs may work and improve, but one with a weak heart or any apoplectic tendency should not go in at all. Drink of all classes is bad, but such drinks as tend to thicken the blood are worse than spirits."—Appleton's Popular Science Monthly.

TRANSFORMERS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

To design a transformer to meet the demands of practice, the conditions of practice must be considered in full. An induction coil and a transformer merely differ in detail; they are identical in principle.

Construction. A transformer consists of a closed magnetic circuit and two coils of wire. The coil connecting to the source of current is called the *primary*, and that in circuit with the line or lights the *secondary*. In commercial lighting the primary is fed with a current of about 2,000 volts; the secondary delivers the same amount of energy minus loss, at 50 volts. It is natural that the transformer, like any other piece of apparatus, should be of a size consistent with the service it is to perform. Transformers are therefore rated as 5-light, 10-light, 50-light, 100-light, etc. The weight of iron and copper also increases with the number of lights supplied.

Design. The iron and copper used in definite proportions will give the best effect, provided they are of the quality used by large companies. That is, the iron must be of the softest kind and the copper pure. The size of a transformer then depends upon the number of lines of force it contains. In the case at hand, if the number of lines of force per square inch be too high, hysteresis will heat and endanger the construction. It is necessary that the magnetic induction be kept very low; from 8,000 to 12,000 lines of force per square inch, or higher if the designer sees fit. The previous table will give an idea of the losses entailed with higher induction.

Having determined to keep the induction low, the ampere turns required and the weight of copper come into consideration. The rule for calculating the turns is simple, the primary and secondary being individually treated. If the primary receives 2,000 volts and the secondary reduces it down to 50 volts, the ratio between them is 2,000 : 50, or 40 : 1.

This ration of 40 : 1 represents the proportion existing between the turns on primary and secondary.

Each turn on the secondary is counterbalanced by 40 on the primary. The rule for keeping this fact in mind is

$$\frac{\text{E. M. F. Secondary}}{\text{E. M. F. Primary}} = \frac{\text{Turns Secondary.}}{\text{Turns Primary.}}$$

The method of calculating the turns on the primary is as follows :

$$\text{E. M. F.} = \frac{\text{Turns} \times \text{Lines force} \times \text{frequency.}}{100{,}000{,}000.}$$

The arbitrarily adopted factors are the turns and lines of force. The frequency is from 100 to 150 at the utmost. To illustrate the above, take a case as follows : A dynamo producing 2,000 volts is to be connected to a transformer which will reduce it down to 50 volts ; we now have

$$2{,}000 = \frac{\text{Turns} \times \text{Lines force} \times \text{frequency.}}{100{,}000{,}000.}$$

Adopting a frequency of 100 per second, the above becomes

$$2{,}000 = \frac{\text{Turns} \times \text{Lines force} \times 100.}{100{,}000{,}000.}$$

Adopting 1,000,000 lines of force, we have

$$2{,}000 = \frac{\text{Turns} \times 1{,}000{,}000 \times 100.}{100{,}000{,}000,}$$

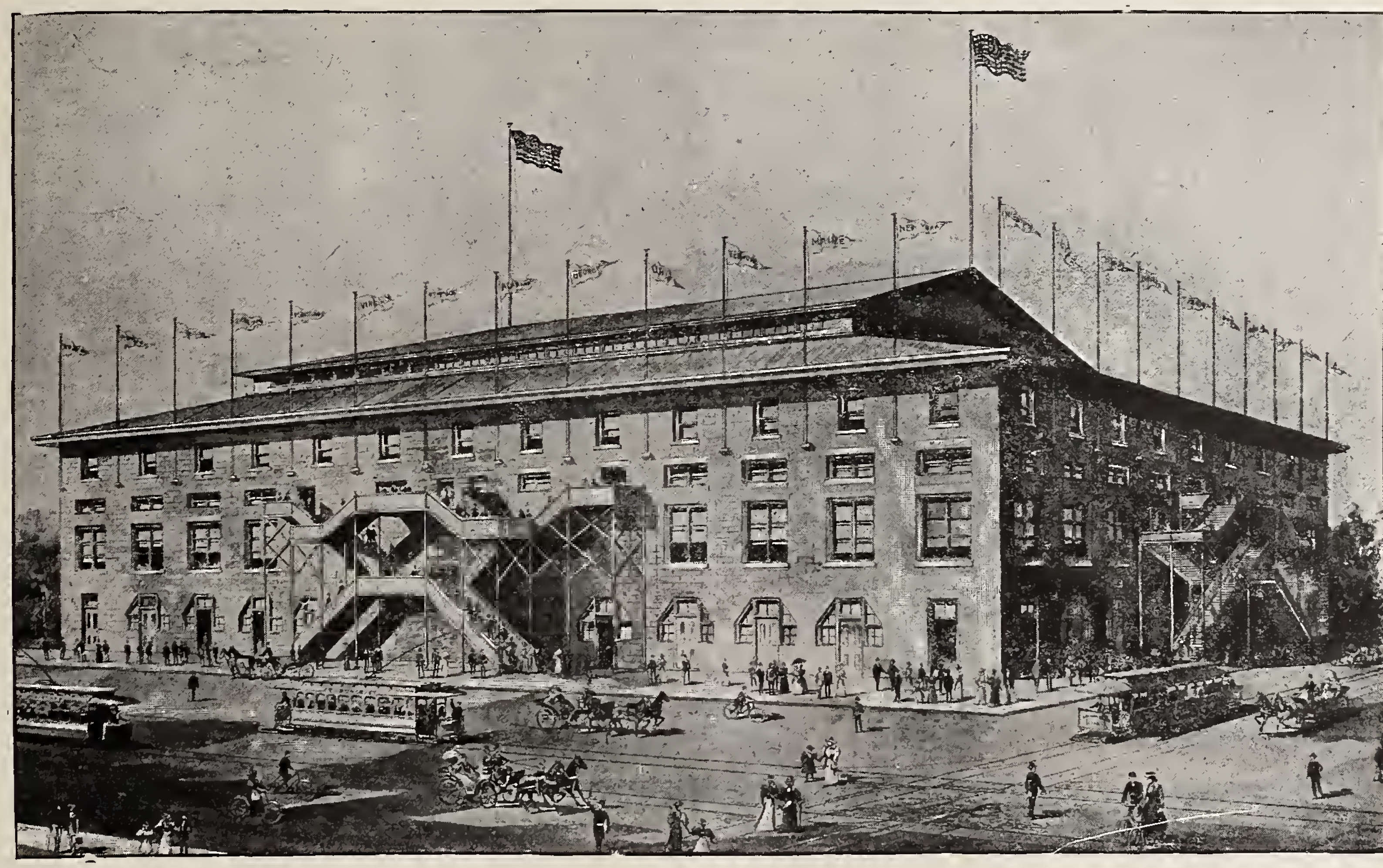
which gives us 2,000 turns with that frequency and induction required. The reduction of turns for the secondary follows in proportion of the pressures. The secondary in this case requiring one-fortieth as many turns; that is to say, 50. When the transformer is at full load the current circulates freely in the primary coil, and therefore in the secondary. When the load is off, the primary being always in circuit, still receives current, but to a very slight degree. The current passing through the primary increases automatically with the demands made upon the secondary. When the lights are gradually turned on, the secondary uses more current; the primary being sensitive to these conditions, receives more and thus keeps up without interruption the cycle of changes. Large power plants have been erected abroad and in this country that use this system of transformation and transmission. The Ferranti system in London is one of the greatest in the world.

The Great Experimentalist.—It was Faraday who put a stop to the invention of ethers, by suggesting that the so-called luminiferous ether might be the one concerned in all the different phenomena, and who pointed out that the arrangement of iron filings about a magnet was indicative of the direction of the stresses in the ether. This suggestion did not meet the approval of the mathematical physicists of his day, for it necessitated the abandonment of the conceptions they had worked with, as well as the terminology which had been employed, and made it needful to reconstruct all their work to make it intelligible—a labor which was more distasteful as it was forced upon them by one who, although expert enough in experimentation, was not a mathematician, and who boasted that the most complicated mathematical work he ever did was to turn the crank of a calculating machine; who did all his work, formed his conclusions, and then said: "The work is done; hand it over to the computers."

The Mystery of the Ether.—We are now assured that there is something else in the universe which has no gravitating property at all, namely, the ether. It was first imagined in order to account for the phenomena of light, which was observed to take about eight minutes to come from the sun to the earth. Then Young applied the theory to the explanation of polarization and other phenomena; and, in 1851, Foucault proved experimentally that the velocity of light was less in water than in air, as it should be if the wave theory be true, and this has been considered a crucial experiment which took away the last hope for the corpuscular theory and demonstrated the existence of the ether as a space-filling medium capable of transmitting light waves known to have a velocity of 186,300 miles per second. It was called the luminiferous ether, to distinguish it from other ethers which had also been imagined, such as electric ether for electric phenomena, magnetic ether for magnetic phenomena, and so on —as many ethers as there were different kinds of phenomena to be explained.

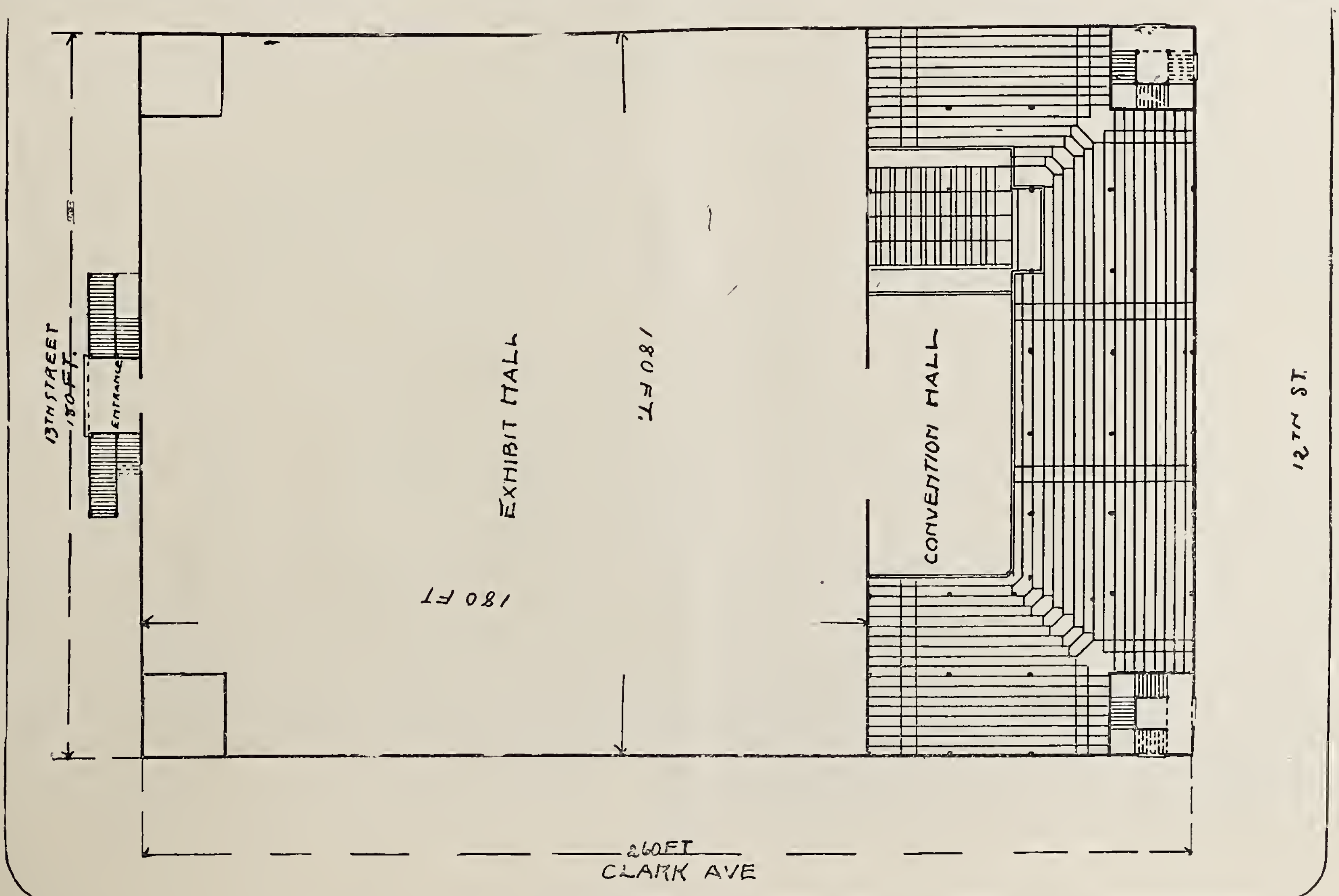
CONVENTION OF THE AMERICAN STREET-RAILWAY ASSOCIATION.

The committee having in charge the assignment of



EXPOSITION BUILDING.

space for the exhibitors at the coming American Street-Railway Association Convention have thus far received applications for upwards of 30,000 square feet. It is gen-



PLAN OF HALL.

erally understood that no space will be assigned after Aug. 16, and that all available space has been taken. We therefore make the announcement to all manufacturers desiring to exhibit to communicate with Mr. G. W. Baumhoff, care of Lindell Railway Company, St. Louis, Mo., on or before Oct. 1. There will be no question about suitable space for all who desire it.

The list of subscribers to date and of papers to be read at the convention are also given. Mr. T. C. Penington will supply further information in his capacity as secretary and treasurer of the above. The Association address

is No. 2020 State street, Chicago, Ill.

Papers for the Convention, American Street-Railway Association.

H. M. LITTLE.

"Track and Track Joints; Construction, Maintenance and Bonding," by M. K. Bowen, Superintendent, Chicago City Railway Company, Chicago.

"Trucks," by John N. Akarman, Superintendent Worcester Consolidated Street Railway Company, Worcester, Mass.

"How Can the Revenue of Street Railways be Increased, Taking into Consideration the Collection of Fares, Method of Registry, Transfers, Use of Tickets or Cash Fare, and Attractions Along the Line of Road," by C. Donsmore Wyman, General Manager Milwaukee Street Railway Company, Milwaukee, Wis.

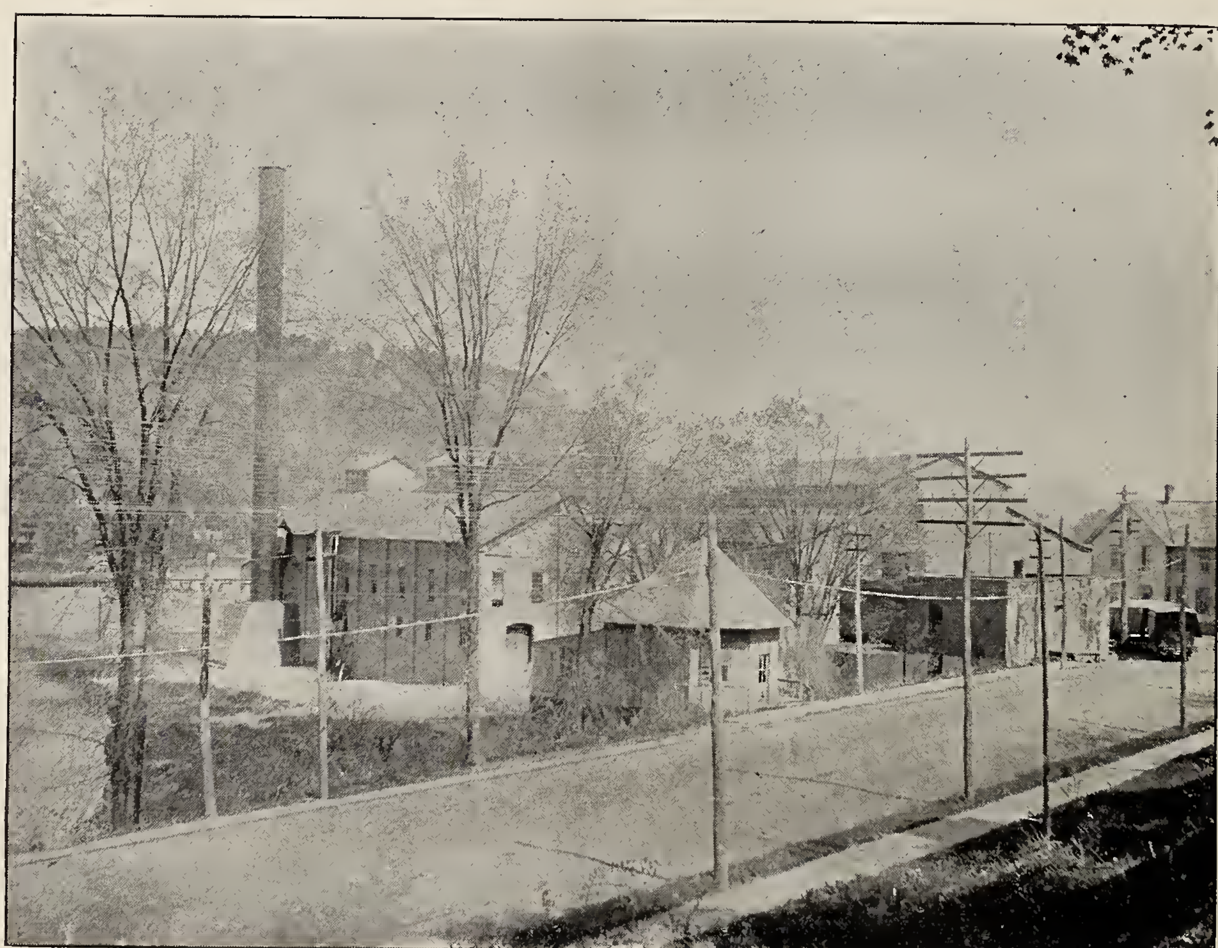
"The Modern Power-House," by Richard McCulloch, Engineer Citizens' Street Railway Company, St. Louis, Mo.

"Modern Overhead Electric Construction," by B. Willard, Superintendent New Orleans City and Lake Railroad Company, New Orleans, La.

"Selection and Management of Employees" (to be read at executive session), by W. F. Kelly, General Manager Columbus Street Railway Company, Columbus, O.

Application for Space at the Convention of the American Street-Railway Association, St. Louis.

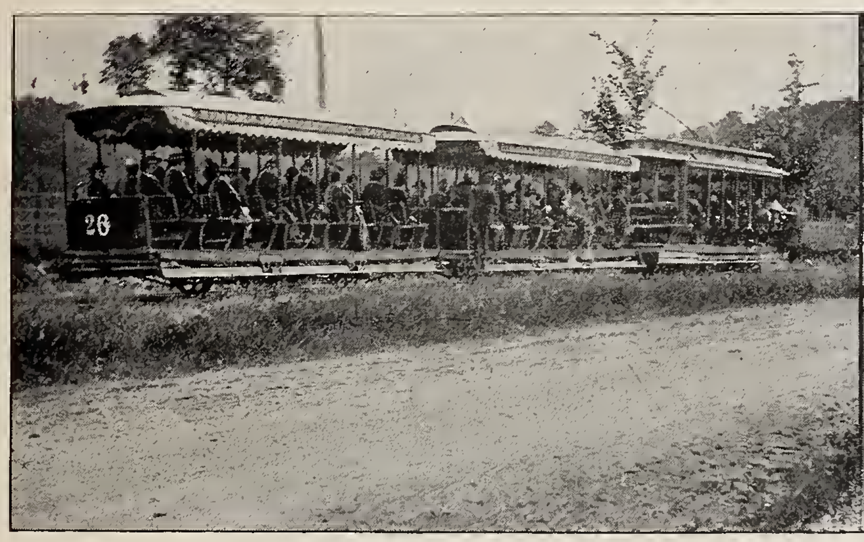
Shickle-Harrison & Howard Iron Co., Commercial Elec. Supply Co., "Street Railway Review," National Lead Co., American Electric Heating Corporation, Consolidated Car Fender Co., Missouri Car & Foundry Co., Missouri Malleable Iron Co., General Electric Co., The Johnson Company, Mica Insulator Co.,Heine Safety Boiler Co., St. Louis Register Co., Devlin Street Car Brake Co., Sterling Boiler Co., Hartford Woven Wire Mattress Co., Standard Air-Brake Co., Leschen-Macomber-Whyte Co., Meaker Mfg. Co., H. W. Johns Mfg. Co., The Diamond Truck Co., Paige Iron Works, J. G. Brill Car Co., The Peckham Motor Truck & Wheel Co., E. T. Burrowes Co., Scarritt Furniture Co., The Sargent Co., Wm. Wharton, Jr., & Co., The Creaghead Engineering Co., Theodore Fletcher, Chas. G. Smith, Munson Electric Conduit Co., Partridge Carbon Co., The Graham Equipment Co., Safety Car Heating & Lighting Co., American Car Co., Consolidated Car Heating Co., Central Union Brass Co., Walker Co., The Trojan Button Fastener Co., Given Campbell, The Adams & Westlake Co., R. D. Nuttall Co., Shultz Belting Co., Western Electric Supply Co. (for the Ohio Brass Co.), International Register Co., Gold Street Car Heating Co., Mundy Mfg. Co., Brussells Tapestry Co.



POWER PLANT AND CAR HOUSE NO. 1, BINGHAMTON R. R. CO.

STREET RAILWAY CONVENTION OF THE STATE OF NEW YORK.

The next annual convention of the Street-Railway Association of the State of New York will be held at Hotel Bennett, Binghamton, Tuesday, Sept. 8,at 10 o'clock a.m.



ELECTRIC CARS EN ROUTE TO ROSS PARK.

A VIEW IN ROSS PARK.

It is the intention of the Association to make the meeting one of especial benefit and importance. The interests of supply and street railroad men being so closely allied, we believe a more intimate acquaintance and interchange of ideas would prove beneficial to both, therefore we should be pleased to see a liberal attendance of supply men. We trust you will find it convenient to send one or more representatives, including heads of firms.

ALONG THE LINE OF THE TROLLEY.

It is intended to make the exhibit of supplies, small models, etc., a prominent feature of the convention, and ample room will be provided (free of expense) for all who desire to make a display.

At the last annual convention of this Association a resolution was introduced whereby supply men could be made associate members of the Association, paying membership fees and dues, to assist in defraying the expenses of the Association. After a thorough and lengthy discussion, participated in by the supply men themselves, it was considered wise and expedient not to adopt the resolution, but the privilege of all conventions was extended to supply men, and they were cordially invited to participate in the exercises and entertainment provided, and the only outlay asked was an assessment of $5 each to defray the expense of the banquet, which would entitle the contributor to a ticket to the same.

Aside from the banquet the Binghamton Railroad Company have arranged an excellent programme of entertainment, including a trolley ride to the various points of local interest, including Ross Park, the State Hospital, terminating with a ten-mile ride to Union, with luncheon at the Casino, provided by the Binghamton, Lestershire and Union R. R. Company, to which all visitors, including supply men, are invited.

The following includes a list of the subjects to be discussed, and the programme covering the convention proceedings. Mr. G. F. Rogers, President, will supply further information to those desiring it.

4. Report of the Executive Committee.
5. Minutes of special meeting of the Executive Committee.
6. Report of the Treasurer.

VIEW ON STATE STREET.

Programme of the Fourteenth Annual Convention of the Street-Railway Association, State of New York, to be held at Hotel Bennett, Binghamton, Tuesday, Sept. 8.

9:30 a. m. Meeting of Executive Committee.
10:30 a. m. Meeting of the Association.

7. Reading of reports on practical street railroad questions, by well-known gentlemen; names and subjects to be announced.
8. Discussion ensuing.
9. General business:
   I. Appointment of Nominating Committee.

HENRY STREET, WEST OF CHENANGO.

Order of Business

1. Call of the roll.
2. Approval of the minutes.
3. Address of the President.

   a. Nomination of officers.
   b. Selection of place of next meeting.
   II. Election of officers.
10. Adjournment.

11. General entertainment, including trolley ride to Ross Park, State Hospital and other local points of interest, terminating with a ten-mile ride to Union; luncheon served at the Casino by the Binghamton, Lestershire and Union Railroad Company.

12. 8:30—Banquet at Hotel Bennett.

Topics of Papers and Discussion at the Fourteenth Annual Convention of the Street-Railway Association of the State of New York, to be Held at Binghamton, Sept. 8, 1896.

Points of financial organization.

Car-mileage record. Its advantages.

Improvements needed in electric motors.

Suggestions for special track construction.

How can we increase travel, especially in smaller cities?

General track construction and the most approved method.

Is selling tickets at reduced rates an advantage or disadvantage?

The maintenance of power-station from an economical standpoint.

A description of the "Gorge Road" at Niagara Falls.

COURT STREET, LOOKING WEST.

(Allotted.)

Street railroads vs. State: Their relation to each other. (Allotted.)

How to keep car-bodies clean? A plan for daily inspection and care.

HOTEL BENNETT, WASHINGTON STREET.

The use and abuse of transfers: Are they advantageous? (Allotted.)

Fenders: Are they practicable? Their advantage and

disadvantages.

Construction and maintenance of trucks and care of motors. (Allotted.)

Overhead construction; maintenance of same, and suggestions for new work.

How can we prevent accidents and increase the general efficiency of employees?

The best method of and the advantages gained by rotating crews and distribution of runs.

How to prevent collusion on the part of motormen and conductors to defraud the company.

Interurban electric roads: Possibilities and advantages from a financial standpoint. (Allotted.)

The relative advantages and disadvantages of single and

CITY OF BINGHAMPTON.

double trucks for interurban service.

Can small electric roads be operated to advantage in conjunction with small electric light companies?

Report blanks, time sheets, etc., and their general usefulness to the superintendent. Suggestions for forms.

country. They have installed some of the largest alternating plants in this country.

Notices of bids to be received by the Warden for furnishing electrical machinery will shortly be sent out.—Ohio Penitentiary News, Columbus, O.

ON THE OUTSKIRTS.

The proper form of liability insurance. Can a company insure themselves to advantage by establishing a fund?

The daily inspection and care of car equipments. How to accomplish the best results with the least expense.

The daily record-book of conductors' returns—its necessity and advantages. Suggestions for headings.

The best method of promoting personal interest on the part of the employees in the affairs of the company.

Signals and inter-communication with reference to maintenance of schedule on single-track street railroads.

What is the proper and most efficient method of protecting a street railroad company from dishonesty of employees?

Street railway legislation: How can it be met to best subserve the interests of street railroad companies and the public?

Street car wheels: Should they be made heavier, to avert possibilities of accident? Is it possible to establish a standard?

How shall we prevent pounding down of track joints? How shall we remedy the evil, when it exists, without replacing entire track?

The comparative advantages and disadvantages of operating long and short cars. The extra expense and increased capacity considered.

Power from the trolley circuit. Is it practicable? Why do the fire insurance companies object? What should be done to overcome the objection?

Pleasure resorts and their advantages to street railroads. Are they profitable? How should they be conducted and maintained to attract the largest number of people and secure permanency?

Can cities of less than 15,000 inhabitants support a street railroad of moderate mileage, carefully and well built at present prices, without over-capitalization of costs, owned and handled by local parties? What measure of profit can be expected therefrom?

Marshall D. Barr, of No. 39 Cortlandt street, New York, the representative of the Stanley Electric Manufacturing Company, is very much pleased with the outlook for business this fall, If the future continues to look as bright, they will have the lighting business of the

A GREAT CLAMBAKE.

To meet, means frequently to eat. The modest abilities of our own fellow-professionals are well known. They like to eat in chorus; the expression is excusable because it is true. We will not say from times immemorial, but at least for a period of eighteen years, a mighty clambake has been given annually by a most delightful entertainer, Mr. Eugene F. Phillips, of the American Electrical Works.

Situated on a high prominence, the picturesque clubhouse, with its many-sided views of turf and sea, gives to the Pomham Club a location of the most pleasurable surroundings.

The guests, as the Bible says, knew that the place was good; they distributed themselves on all sides, frequently forming nebulous clusters around a bowl—a large bowl—from which an odor of joy arose. Its balmy influence did not steal over the beings of those that had quaffed with more glowing touch than the cool, salty and most refreshing breezes from old Narragansett Bay.

Many saw in "punch bowling" a happiness that the alley beyond did not bring; yet the division of sentiment was such that the ninepins cracked to a lively tune and the lignum vitae spheres hummed as they sped—

"Merrily we bowl along."

Mr. Phillips supplied the guests with large-brimmed hats of straw. They did not interfere with their finding what they wanted on the bill of fare—although solely to the credit of the menu, some ordered the same thing twice.

The clambake was apostrophized on all sides, for the edible quality of the clams are famous. Many bivalves parted from their shells with martyr-like resignation at the ecstasy their hasty destruction produced. Clam chowder was the watchword, breathed with unspeakable emotion. A delicate lunch was served at 11:30, consisting of lobster salad, Quahaugs on the half-shell, doughnuts, Queen olives, crackers and cheese, macaroni with cheese, butter sandwiches, stewed liver, wine sauce.

This slight repast procured sufficient appetite for those who felt their powers waning to comfortably indulge in the following:

Chowder—Clams, fish, French rolls, brown bread. Fish—Broiled blue, a la Maitre d'Hotel, fried eels, clam cakes, salmon and cream with peas, soft shell crabs, Lyonaise potatoes, Saratoga chips, succotash, tomatoes, cucumbers. Baked.—Clams, lobster, Quahaugs, clam water, sweet corn. Pudding—Suet, brandy sauce. Fruit, watermelon. Ice cream—Neapolitan, lager beer, black coffee, Apollinaris, Pomham spring water, ginger ale, Lithia water, sarsaparilla.

The menu was contained in a folding card of a delicate blue, with a silver clam hoe, and the mottos, "Don't Be a Clam," and "Hoe Your Own Row," beside it.

The hoeing done on some rows was marvellous. Cigars closed this great gastronomic event, and the toasts which added a flow of reason to the otherwise palatable drinks were delightfully participated in.

Colonel Ballou filled the honorable position of toastmaster, introducing the speakers. Mr. R. F. Ross spoke about the "Electrical Press;" Mr. Phillips, with earnestness and pathos, delivered a toast "To the Departed;" Mr. Thos. D. Lockwood one on the "Telegraph and Telephone;" Col. J. C. Wyman on "Love and Duty;" Mr. H. B. Cram on the "Electric Light," and Captain Brophy on "Electric Railways." With a deep and sincere vote of thanks to Mr. Phillips and the American Electrical Works for their kindness and unflagging courtesy, the guests disbanded.

They went home to dream of unending menus, oceans of chowder and a fond love for Mr. Phillips and the immortal punch bowl.

POSSIBLE CONTRACTS.

Monterey, Cal.—Arrangements have been completed for the placing of the large electrical plant at the Little Sur River, twenty-four miles down the coast from Monterey.

Bluffton, O.—A. Boardman, Jr., of Findlay, has been granted a franchise by the council to put in an electric light plant at this place at once.

Oconto, Wis.—Sealed bids will be received on or before Monday, Sept. 14, 1896, at the office of the city clerk, Oconto, Wis., for furnishing electric light to said city of Oconto. Bids are to be for furnishing not less than fifty (50) 2,000 candle-power arc lights, burning all night and every night. Lights are to be furnished by Feb. 1, 1897, and they are to be for a ten (10) years' contract and for a stated sum per annum for each light. The city is to have the right to take any number of additional lights at same rates.

Bath, Me.—The Bath Gas and Electric Light Company have made plans and are already putting them into operation, for the largest electric plant in the State. Aside from furnishing power for the Hyde and Shaw companies, it will furnish power for the motors of the Bath Iron Works, and then will have surplus enough to run every motor in town.

Philadelphia, Pa.—Joseph Bird, contractor, No. 1029 Race street, has been awarded the contract for a church to be erected in Holmesburg by Architect H. A. Roby, of Lebanon, Pa. Electric combination gas fixtures will be used throughout. The cost of the edifice, including seats, etc., is not to exceed $50,000.——George L. Sipps, contractor, was granted permission by the Bureau of Building Inspection, to erect an eight-story brick hotel at Nos. 111 and 113 South Tenth street, for A. F. Bornot, owner, to cost $60,000.——Jacob Myers & Son, contractors, have been awarded the contract for the erection of the Dental Hall for the University of Pennsylvania, at Thirty-third and Locust streets. The operation will cost $100,000.

Waynesboro, Ga.—A movement is being agitated for the erection of an electric light plant.

Sycamore, Ill.—Sealed bids will be received by the city of Sycamore for four hundred white cedar poles, f. o. b. cars, Sycamore, as follows: One hundred poles, 35 feet long, 6 inches at the top; three hundred poles, 30 feet long, 6 inches at top. All poles must be straight, live and sound. Bids must be in by Sept. 12, 1896. Address Virgil Bollinger, chairman electric light committee, Sycamore, De Kalb County, Ill.

Tonawanda, N. Y.—A franchise has been granted to the Niagara Falls Power Co., giving it permission to construct and operate transmission lines in this city.

Norwood, O.—A new $20,000 three-story brick building is being erected as an addition to the present main building of the St. Joseph's Foundling Asylum. The new building will be fitted out with electric lights and will be heated throughout with steam.

Stucky & Heck, of the Electrical Manufacturing Co., Ltd., No. 35 N.J. Railroad avenue, Newark, N.J., are busily engaged in their shops repairing and constructing dynamos and motors of all descriptions. They are expert electrical and mechanical engineers and draughtsmen, having had 19 years' experience in managing the construction of electrical machinery. They give special attention to street car motors, accumulators and appliances. They handle woven-wire dynamo brushes and other specialties. Their work covers rewinding, repairing and reconstructing armatures, dynamos, power generators, motors and transformers. The long-distance telephone, No. 977, will reach them. For rapid and careful work they have no competitors.

H. M. Little has been chosen vice-president and general manager of the Metropolitan Street Railway Company.—N. Y. Mail and Express.

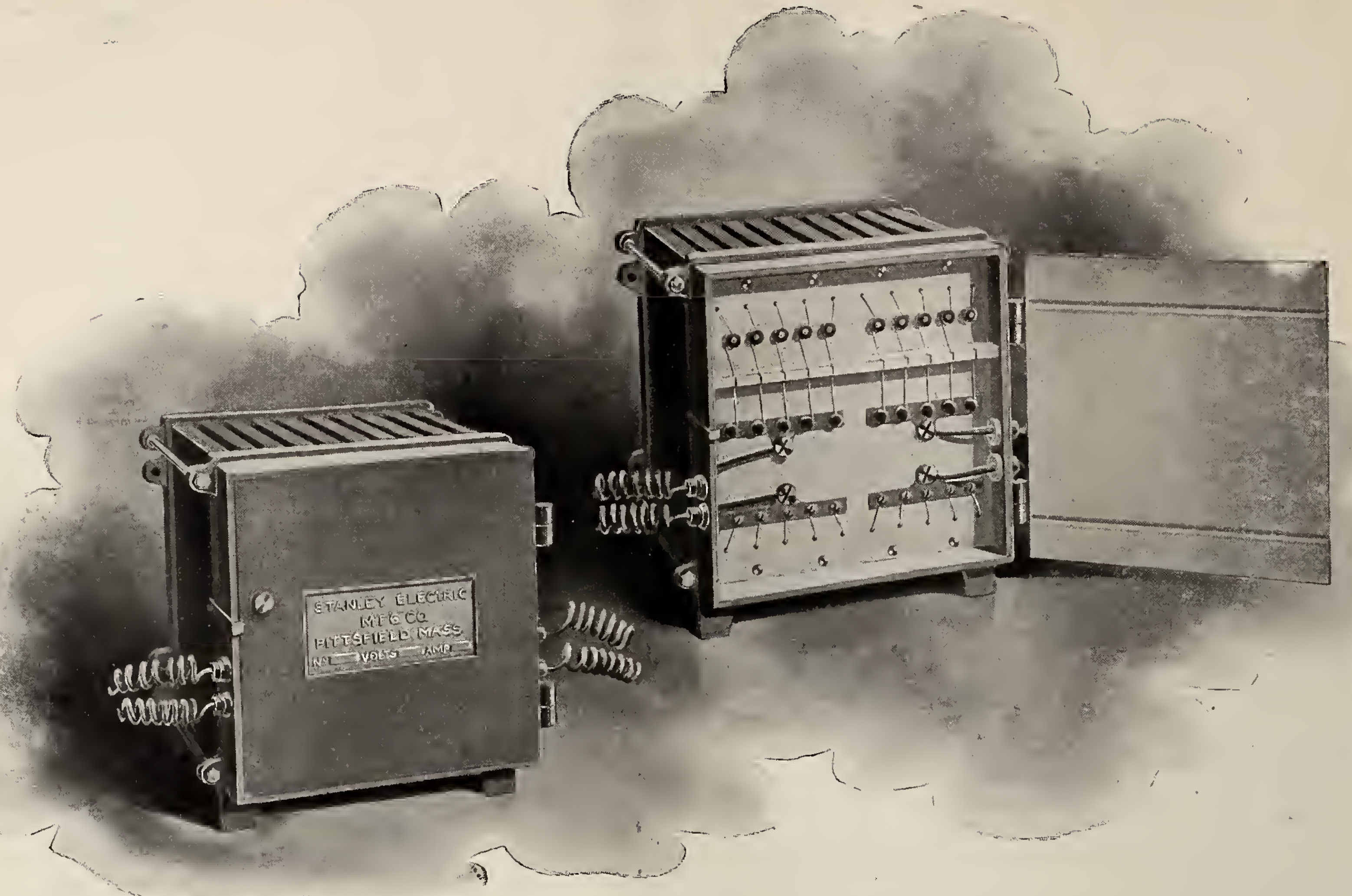
The Electrical Age.

Vol. XVIII., No. 10. NEW YORK, SEPTEMBER 5, 1896. Whole No. 486

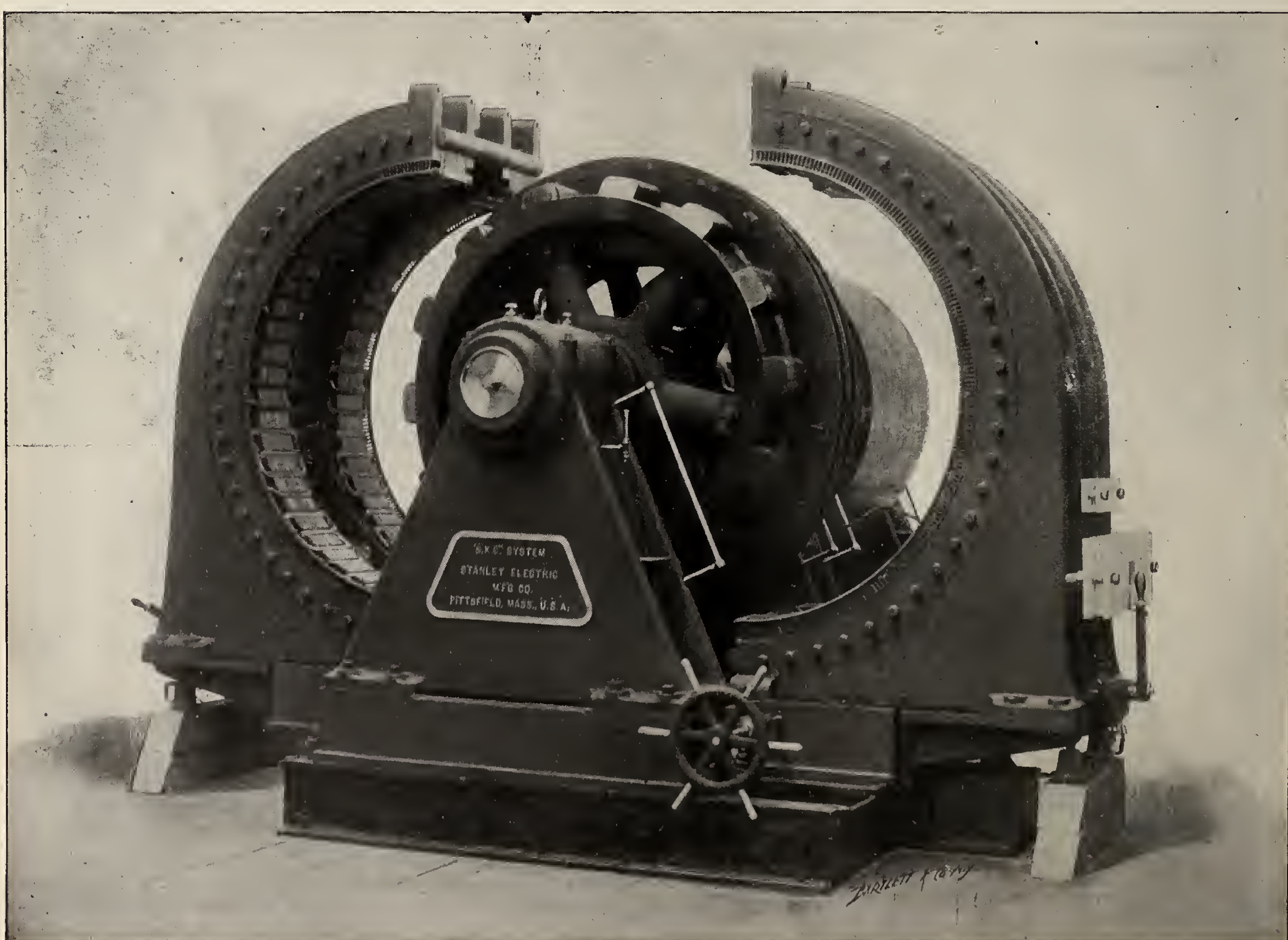
THREE 500-KILOWATT GENERATORS.

A GREAT ENGINEERING FIRM.

It has been commonly supposed that the greater growth of electrical manufactures has been in the past. It is not difficult to prove that in the present and future we may see it occur. Of all firms that have pursued a single line of industry, none stands forth more prominently than the Stanley Electric Manufacturing Company, of Pittsfield, Mass. The organization, capitalization and development of this company has been made upon a basis that inspires the deepest confidence. It is well for an engineering firm to employ engineers. The Stanley company have done this and the fruitful products large and small of all kinds of electrical machinery are due to the direct efforts of Messrs. Stanley, Kelly and Chesney. We can do no better than quote from their own beautiful catalogue these few lines: "Our history proves that good apparatus honestly made and honestly repre-



S. K. C. CONDENSER USED WITH ALTERNATING CURRENT MOTOR.

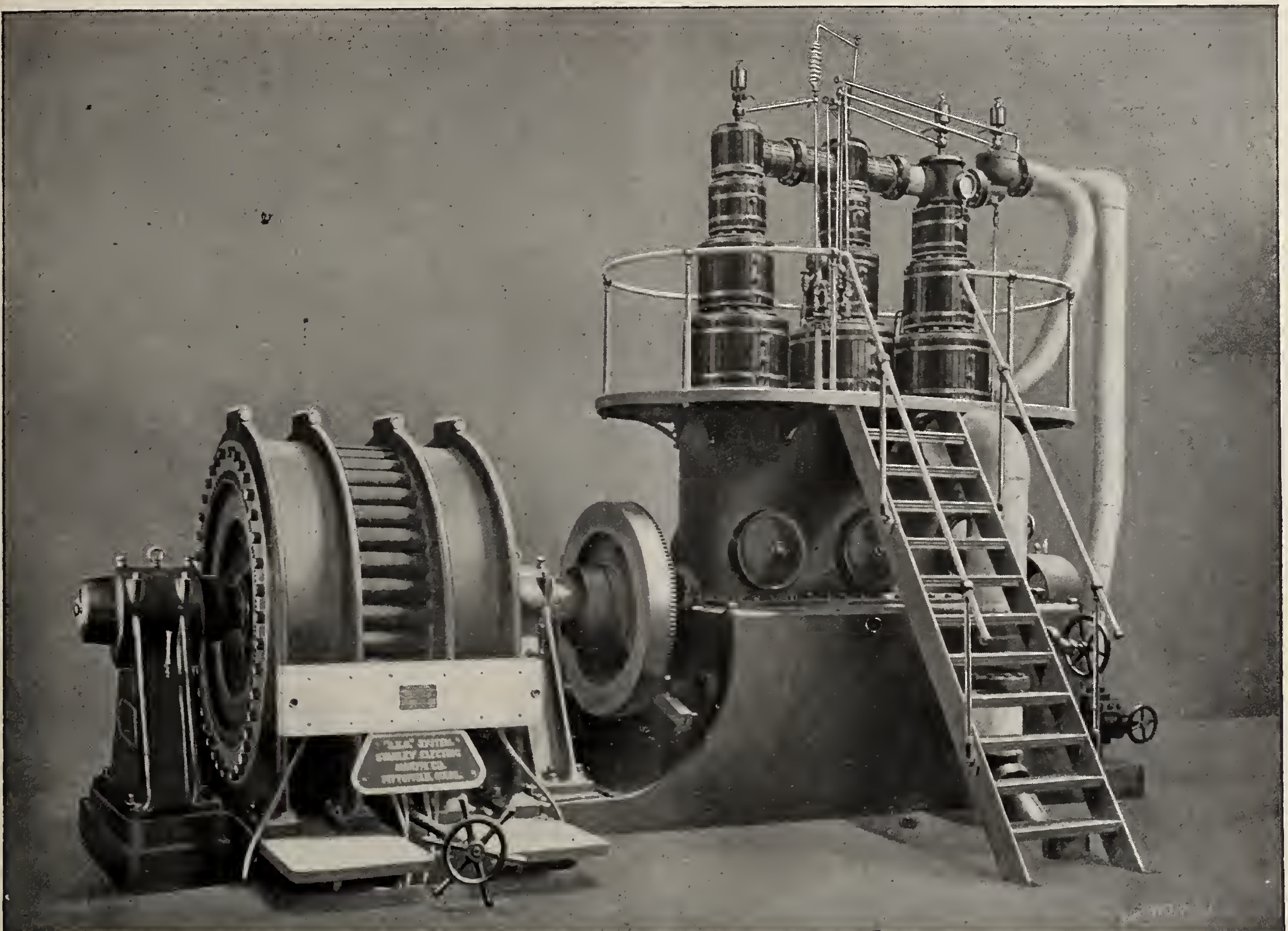


600 KILOWATT S. K. C. GENERATOR ARMATTURE DRAWN APART.

sented can be sold on its merits at a fair price in the face of the most ruinous competition that has ever cursed an industry, and that the public is becoming electrically intelligent to a degree that encourages good work and should discourage a discontinuance of the methods so long pursued by over-capitalized corporations in this business. The time has gone by when the name of a much-advertised inventor, wizard or genius, indefinite millions of nominal capital, Wall street reports, or claims of ownership of patents which cover everything existing or which may be produced, are influential in closing bona fide contracts for the purchase of electrical machinery.

"Manufacturers must now bend every effort to see how good they can make their apparatus instead of how cheap they can make it."

The newness of this country and the great western demands for power and transmission plants have given every opportunity for those who faithfully invest their time, capital and skill to the construction of alternating-current apparatus to succeed. The undeveloped water-power resources of the Rocky Mountains, the rich mines that dot this country in almost every part, are a temptation and an inducement to manufacturer and miner alike. Frequently it is impossible for nature to place the coal mine or waterfall beside the mine of rich ore. It is then that the spur of enterprise reaches into the heart of civilization, and firms whose machines will meet these demands can sell with mutual credit. The Stanley people, as they say themselves, are specialists. "In all branches of industry, as well as in the professions, the best work is done by specialists." It should be a pleasure to all to see the work of such great specialists as these. We have therefore produced for the benefit of our readers some views of the apparatus made and sold by the Stanley Electric Manufacturing Company. It is known without doubt to many that the wonderful progress of the past few years in the design and construction of alternating-current apparatus is directly due to the introduction of two and three-phase machines. This has enabled firms to supply not only light, but power, a thing difficult and impractical in the past. The motor can run as merrily on a polyphase circuit as the shunt dynamo with continuous current. It is necessary to appreciate and understand the vast impetus this new principle has given to the field of alternating current practice. The Stanley company have



300 KILOWATT GENERATOR AND WILLANS ENGINE.

kept apace with the times. Their machines are made for light and power. Generators which regulate within 2% and motors which will carry an overload of 25% are some few of the most excellent products of this firm. The design and simplicity of Stanley motors and generators have given them a world-wide reputation. It is well known in the trade that the unfortunate lack of torque exhibited by alternating-current motors has been exceedingly detrimental to their use. A motor which cannot pull hard when starting lacks a great element of usefulness. The Stanley people have designed a motor whose starting torque is such that it is from 50 to 200% greater than the pull of the motor at full load. We can faintly estimate the value of this in comparison with some of the weak types brought forward by others. The Stanley people call it the S. K. C. motor. For the benefit of our readers we may say that these characters are but the initial letters of an illustrious trio—Stanley, Kelly and Chesney. This motor might otherwise be called the Stanley two-phase motor. It is not of the rotary field type, like Tesla's but consists merely of a motor and a rotating

transformer which continually change their functions. A great point followed out by the Stanley company, and which has a sound scientific basis, is the use of condensers in connection with their motors. They can run a motor and lights from a circuit whose current alternates 8,000 times a minute. Their large size motors have an efficiency of 90% with a variation of speed not exceeding 10%. In connection with turbines, both water and steam, the Stanley generator has shown its efficiency and usefulness. It is not more difficult to operate a two than a three-phase generator. As we have previously remarked, it is excellent for water-power plants and will stand more rough usage than any other machine of known make. For direct-connected plants, a most perfect satisfaction prevails by its use. The remarkable simplicity of the apparatus, its lack of wearing parts, and its solid interior, enable it to compete without any difficulty. The object of a conscientious company is well shown in the nature of these machines; that is, to produce an article whose quality and wear will give it decided prominence in the eyes of engineers. This country is so large and its fields of industry so great that none can afford to place before it crude and unreliable mechanism. We have reached a point where the public mind has become saturated with certain essential facts. It has begun to understand that dynamos must be more than sparking toys. There is no doubt but that those whose ideas in this respect chime in with public sentiment will sell the most machinery, and lay the foundations of a solid and substantial business.

Cleveland, O.—The Adams-Bagnall Electric Company has increased its capital stock from $150,000 to $225,000.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—SLOW-SPEED DYNAMO.

New Orleans, La., Aug. 20, 1896.

To the Editor.

Dear Sir: If it is not infringing too much upon the courtesy of your journal, kindly reply to the following question: Can a dynamo running at 1,200 revolutions per minute be reduced in speed? Is it practical to reduce its speed? You will oblige by answering.

Yours faithfully, Edw. R. Simpson.

(A.)—A dynamo running at 1,200 revolutions per minute can be reduced in speed, and, in fact, any other. It is practical to diminish its speed. Furthermore, although the information is unsolicited, the idea is carried out in two ways. By increasing the strength of the magnetic field, or by increasing the turns on the armature. You might go half way with each successfully.

VIEW IN MAIN MACHINE SHOP OF STANLEY MANUFACTURING COMPANY.

(Q.)—LECLANCHE CELLS FOR ELECTRIC LIGHTING.

Albany, Aug. 28, 1896.

Electrical Age Publishing Co.

Dear Editor: I have made several attempts to run a few electric lights at home by means of batteries. The acid batteries polarize very quickly, it seems to me. I thought that perhaps the great waste occurring when the cells are not used could be obviated by having Leclanche or dry cells in their place. Yours very truly,

P. J. Whittaker.

(A.)—The demands made upon a cell affect its light-giving power and duration; the peculiar power of resisting polarization likewise. Leclanche or dry cells can be effectively used provided the call upon each is slight; that is, if a great number are in use. They are always ready and very convenient. The Acme Bicycle Lamp Company use dry cells with excellent results.

(Q.)—METAL FOR A DYNAMO.

Philadelphia, Aug. 30, 1896.

To the Editor.

Having frequently used your valuable Inquiry Column to great advantage, I am tempted to try once more in obtaining the following information: Can cast iron be used to advantage in dynamo construction? What metal is used at present which is so readily moulded or forged into shape? If I am asking too much, kindly consider it not due to an incipient curiosity. Yours respectfully,

Frank Cushing.

(A.)—Cast iron cannot be used to advantage in dynamo construction. The metal which seems to be cast iron composing the frames of generators is mild steel, or a species of wrought iron that can be poured. Its superiority over cast iron cannot be doubted for an instant. It has all the advantages magnetically of wrought iron, and the easy handling and shaping of cast iron.

(Q.)—MOST SUCCESSFUL SYSTEM OF DISTRIBUTION.

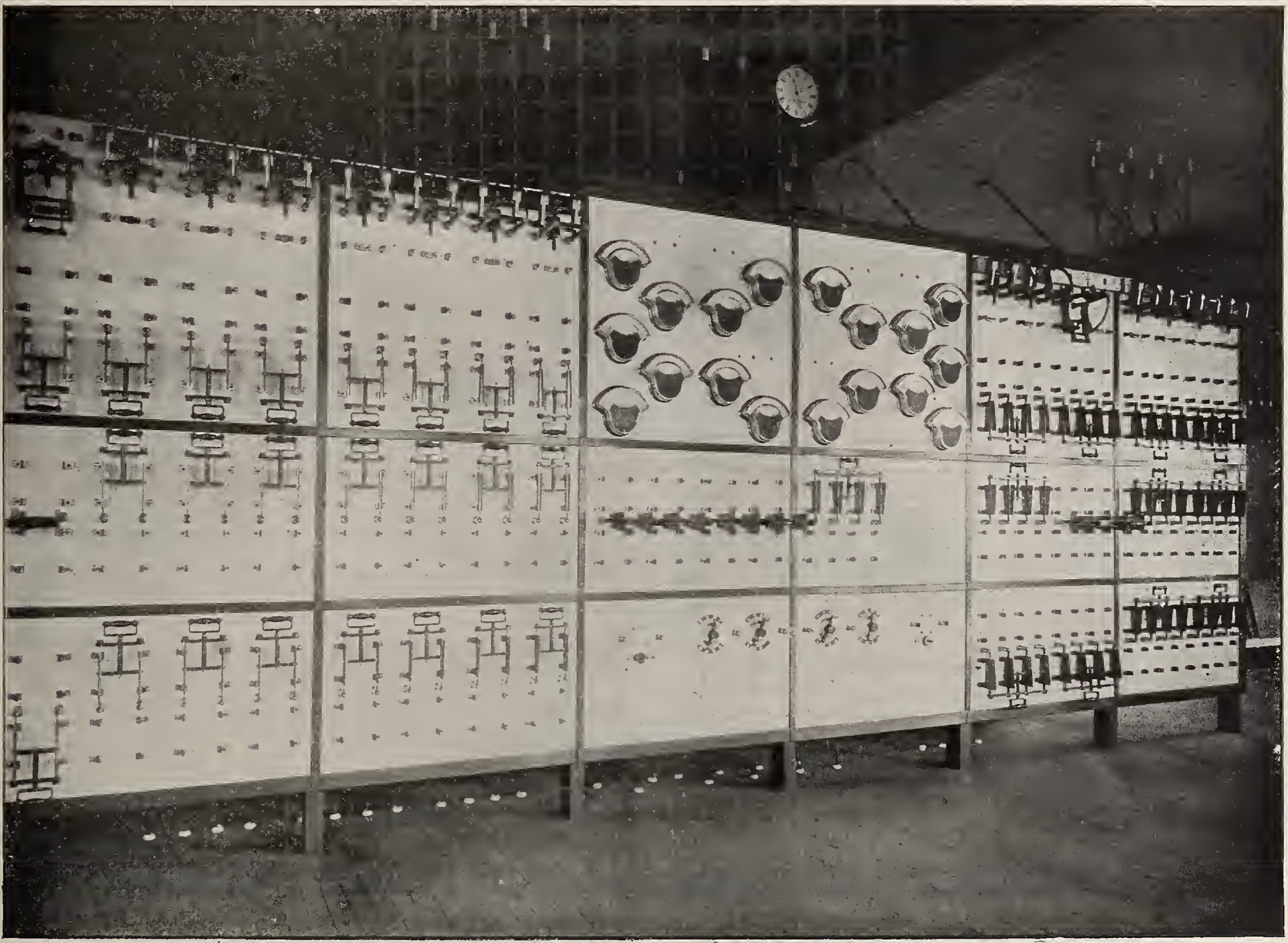
New York Sept. 1, 1896.

Editor Electrical Age.

Dear Sir: A subject of discussion between friends and myself as to the relative excellencies of different systems of distribution has led me to propound to your excellent weekly the question: What system of electrical distribution is the most successful? Although not entering into the above question, I would for private satisfaction like to know whether the system mentioned is electrically superior to all others, or merely owes its development to the efforts of capitalists?

(A.)—We answer the above unbiassedly as to which is the best system of electrical distribution. In our opinion the Edison three-wire system is not only the most successful, but successful due to the fact that it is the superior of all others. Business management may keep a poor or bad thing to the front for some time; it cannot be depended upon to stay there very long if a better exists.

To Clean Rusty Instruments.—Fill a suitable vessel with a saturated solution of stannous chloride in distilled water. Immerse the rusty instruments and let them remain overnight. Rub dry with chamois after rinsing in running water, and they will be of a bright silver whiteness.—Modern Progress.



SWITCHBOARD IN DISTRIBUTING STATION, MONTMORENCY ELECTRIC POWER COMPANY, QUEBEC, CANADA.—S. K. C. System.

Literary Note from The Century Company.—General Horace Porter's personal recollections of General Grant, which "The Century" will publish beginning in November, are to be called "Campaigning with Grant." General Porter first met General Grant at Chattanooga; he soon became attached to his staff, and was with him constantly from that time until the close of General Grant's first term as President, during which he was Grant's private secretary.

At his first meeting with General Grant, General Porter was deeply impressed with the genius and power of the great commander, and he made a practice of jotting down impressions of the important events then crystalizing into history, with full notes of his conversations with his chief. The result is a series of graphic pen-pictures, which will give the reader a close and intimate view of the great general.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 490.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

The data of Table III. and Table IV. are shown reduced and plotted in Fig. 5 and Fig. 6, respectively. Table V. gives values found for the variation in intensity of candles expressed in percentages per millimeter. Table IV. shows, in the way described above, the comparative accuracy of the two methods of reducing candle observations. Fig. 7 shows plots obtained from groups of observations designated by A, B, C, . . . N. Fig. 8 shows plots from three successive sets of bolometric observations.

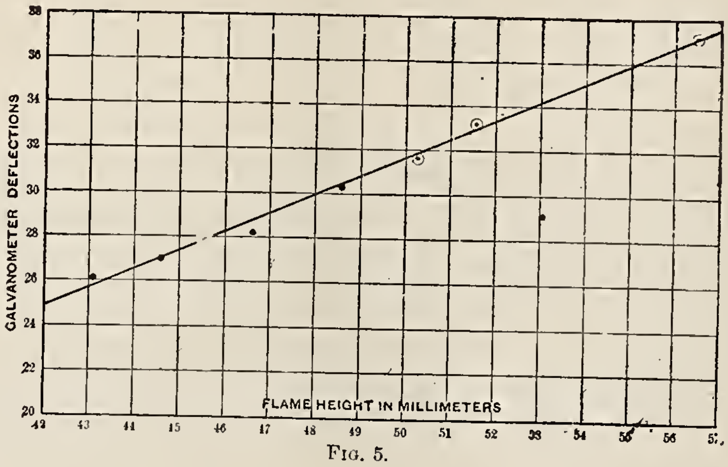


Fig. 5.

An inspection of the tables and curves will show that while the relation between flame height and intensity is a fairly definite one for any given group of observations, there is considerable range of variation in the values for it as obtained from different groups. Moreover, the relation sometimes changes during one burning of the candle. Fig. 8 illustrates this peculiarity, in that there is a group of points marked which lie considerably below the line plotted to represent all the observations; and that the

(Continued on Page 508.)

TABLE V.

Bolometric.	Per cent.	Photometric.	Per cent.	Photometric.	Per cent.
1894. Nov. 29 . . .	2.2	1895. July 27	3.3	1895. Dec. 3 E, G, H	2.3
Dec. 5 . . .	2.7	Oct. 30 . . .	3.4		
1895. Feb. 23, I.	2.2	Nov. 1 I.	3.3		
II.	2.5	II.	3.3		
III.	3.2	Nov. 6 I.	2.2	Dec. 4 I, J, K, L, M, N	2 6
March 21, I., II.	3.1	II.	2.7		
Oct. 4	2.7	Nov. 27 I.	2.7		
		II.	2.9		
		Dec. 2 A.M., A, B	2.7		
		Dec. 2 P.M., C, D, D'	2.8		
Mean . . .	2.7			Weight mean of all	2.7

TABLE VI.

Name of group of observations.	Rate.	Flame height.	C. P. of glow lamp uncorrected.	C. P. corrected for rate.	C. P. corrected for flame height	Deviation from mean corrected for rate.	Deviation from mean corrected for height.	Percentage deviation. Rate.	Percentage deviation. Height.
								o/o	o/o
A	7.601	43.0	6.11	5.99	5.78	+ 0.35	+ 0.04	+ 6.0	+ 0.7
B	8.320	45.15	5.785	6.20	5.80	+ 0.56	+ 0.06	+ 9.8	+ 1.0
C	6.981	44.95	6.01	5.41	6.00	— 0.23	+ 0.26	— 4.25	+ 4.5
D	8.100	46.1	6.09	6.35	6.25	+ 0.71	+ 0.51	+12.6	+ 8.7
E	7.157	46.4	5.52	5.09	5.73	— 0.55	— 0.01	— 9.8	— 0.2
F	7.863	44.7	5.67	5.74	5.62	+ 0.10	— 0.12	+ 1.6	— 2.1
G	8.030	44.8	5.72	5.91	5.69	+ 0.27	— 0.05	+ 4.8	— 0.9
H	7.330	44.05	5.80	5.47	5.66	+ 0.17	— 0.08	+ 3.0	— 1.4
I	8.422	44.3	5.65	6.13	5.54	+ 0.49	— 0.20	+ 8.5	— 3.5
J	7.271	47.1	5.35	5.02	5.65	— 0.62	— 0.09	—11.0	— 1.6
K	7.367	46.15	5.50	5.22	5.67	— 0.42	— 0.07	— 7.6	— 1.2
L	7.440	45.6	5.64	5.41	5.73	— 0.23	— 0.01	— 4.25	— 0.2
M	7.137	42.3	6.00	5.52	5.56	— 0.12	— 0.18	— 2.3	— 3.2
N	7.301	44.2	5.79	5.45	5.67	— 0.19	— 0.07	— 3.5	— 1.2
Means, disregarding signs....	7.594	44.9	5.76	5.64	5.74	0.36	0.125	6.35	2.16
Nov. 6, I.		45.5	5.60		5.68		— 0.09		— 1.6
II.		45.3	5.79		6.00		+ 0.23		+ 4.0
Nov. 11		43.1	6.17		5.85		— 0.08		— 1.4
Nov. 12, I.		44.1	5.87		5.73		— 0.04		— 0.7
II.		42.9	6.20		5.85		— 0.08		— 1.4
Dec. 2, D'		49.3	5.36		5.99		+ 0.22		+ 3.8
Means of all, disregarding signs.........		45.0	5.78		5.77	Last six only.	0.123		2.14

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CONTENTS.

	PAGE
EDITORIALS	
Horseless Carriages	507
Prof. Langley	507
GENERAL SUBJECTS	
Standards of Light	506
Electric Railways	510
MISCELLANEOUS	
Electrolysis of Water Pipe	507
EXTRACTS	
Interesting Facts in Science	509
TRADE NOTES	
A Great Engineering Firm	501
A Great Panorama	514
Walker Company	514
Canadian Letter	515
Possible Contracts	515
Telephone Notes	515
Schiff, Jordan & Co	513
INQUIRY COLUMN	504
NEW CORPORATIONS	515
New Telephone Companies	516
PATENTS	516

HORSELESS CARRIAGES.

The English have not been deficient in their interest for the horseless carriage. They have progressed so far that it seems likely their work in this respect will surpass our own.

Vehicles that were moved by other than flesh and blood were not allowed to traverse the English tramways without a man waving a red flag preceding it. Fortunately a bill has passed the Houses of Parliament repealing this ancient law. The proximity of England to France has had much to do with the growth of that industry there. The superb roads covering all of England, hard and solid, since the earliest Roman days, would give unequalled facilities to riders on these strange rigs. The difficulty in selecting a clean and cheap source of power has stood in the way of progress. Oil, gasoline, petroleum and gas have been used.

The use of storage batteries, with their entailed weight, adds a grave item of disfavor to their use. There is no doubt about the reception an electric carriage would receive that weighed less, power for power, than a petroleum, oil, or gas carriage; but the melancholy fact remains that at present there are none.

What then can be done to mitigate this difficulty? The charm of fast travel in a vehicle self-controlled and able to squirm its way through countless others is too great to be dropped. We heard of a firm in London that manufactured plates of compressed lead oxide called lithanode. Maybe the electric carriage question could be quickly brought to an issue by the use of storage cells with plates of this lightness and serviceability.

If any if our friends have a new form of primary battery which does not use zinc, walk it forward, its use is evident.

PROFESSOR LANGLEY.

There have been but few men competent in the past or future to undertake a work of the nature of Professor Langley's. The efforts of past workers have been marked by many tragic incidents. There is no doubt but that a risk of life attends experiments with air ships or flying machines. The object of Professor Langley is distinct from that of the majority of his predecessors. Rapid flight through the air by motive power other than human has been the object of his labors and thought. To see the bird skimming along through the atmospheric ocean with unhesitating movements is sufficient to rouse the most sanguine hopes in an inventor's breast.

The possibility does not defy us. There seems to be no physical incompleteness, no missing factors, no need of mere imagination to enable us to fly. Professor Langley is studying the motion of the aeroplane through space. Its reactive qualities when endowed with power, its ability to lift and move. The relations once clearly understood between the weight to be carried, the velocity, inclination and area of the plane, and the clouds of doubt will slowly be swept aside. Lilienthal has immolated himself in his efforts to fly. Maxim with greater caution ceased because of the dangers of aerial navigation. There is still a strong heart beating. There is still within the lists a champion that has not heard of failure.

ELECTROLYSIS OF WATER PIPES.

Kansas City and Detroit are discussing the question of the action of the electric currents of the street railway lines on water pipes. In Kansas City the question is becoming quite serious, and Prof. L. I. Blake has recently made a report to the water board attributing the pitting of water pipes and their ultimate destruction to the defective bonding of the rails, which should act as the return conductor. When the current can not all return to the dynamo at the power house, through the conductors provided for it, the nearest good conductor is utilized. This is probably a water pipe. Where the current enters the pipe there is no action upon it, but at the nearest point to the dynamo at the power house, the current must leave the main and go to the dynamo through the ground. At this point the electrolytic action is serious. The remedies are to improve the bonding of the rails so that the current can all get back through them, and to connect the water pipes at the points where electrolysis is observed by adequate metallic conductors to the dynamo. This latter remedy requires careful examination of the pipes at all suspected points and complete metallic connection with the return circuit of the railroad. Many cities, among them Brooklyn, Providence, Detroit, St. Louis, St. Paul, Milwaukee, Cincinnati and Chicago have experienced the same trouble. Its source is now quite well understood, and the remedy is not very difficult of application. Judge Davidson, of Montreal, is reported to have ruled recently that the street railway company has a right to use the earth for return circuit, and dismissed the action for $27,000 instituted by the Bell Telephone Company, after much expert evidence had been heard. It is not stated whether the matter of electrolysis of conduits was included in this particular case or not. The right to use the earth for a return circuit, if unrestricted, will, however, affect the rights of every company or corporation having water or gas pipes or conduits underground, in addition to the effect upon currents in other electrical circuits. The general opinion seems to be that the electric current of street-car lines is the later occupant, and the company using it must take care that its use does not injure prior occupants or those doing no injury to any one else by their systems of pipes or conduits.—Municipal Engineering.

slope of the flame height-intensity curve plotted from the points marked   is materially different from that obtained from other groups of points. This may be due to a change in the shape of the wick. The fact that this relation is not absoluately constant does not vitiate the proposed method of treating candle observations; for since the deviations of flame height from 45 mm. is seldom more than 10%, if our assumed value for this relation is in error by as much as 20% our reduced value for candle-power would be in error by no more than 2%.

Table VI. shows that the mean deviation from the mean of observations corrected in this way is a little over 2%, and that 14 out of 21 values were in error by 2.1% or less. In the case of corrections for rate, the mean deviation is over 6%, while but 1 out of 14 values deviated by less than 2% and only four by less than 4%.

In other words, by correcting for flame height an error of less than 2% may reasonably be expected, and the probability of making an error greater than 4% is small; while in correcting for rate, errors of 8% and 9% are of common occurrence.

The values corrected for rate might, perhaps, be more consistent if the rule were followed to reject all observations in which the rate fell below 114 or above 126 grains per hour. Similarly, the errors in the values correctel for flame height might be smaller if observations made at extreme flame heights were to be rejected. Indeed, it is one of the chief advantages of the method, that the observed flame height furnishes a criterion for the rejection of any observation which is regarded as doubtful. In this discussion, however, in order to be equally fair to both methods, no observations have been rejected.

The results of these photometer observations confirm fully those obtained by the use of the bolometer in determining the variations of light standards, and show very conclusively that the fundamental assumptions on which the bolometric tests were based were entirely justifiable. If we compute from Table VI. the mean value of the flame height-intensity ratio, as determined by the bolometer, we find that it is just the same as the mean value from all the observations.

In section III. of this report it was shown that the

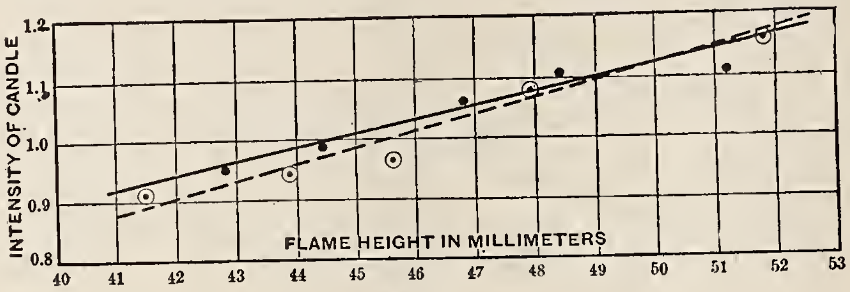


Fig. 6.

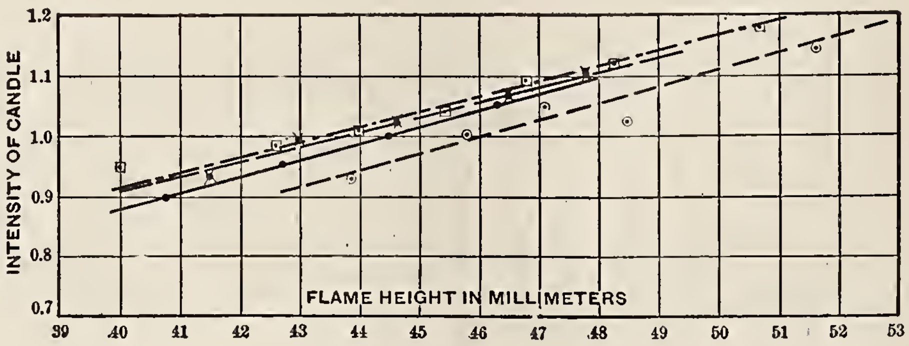


Fig. 7.

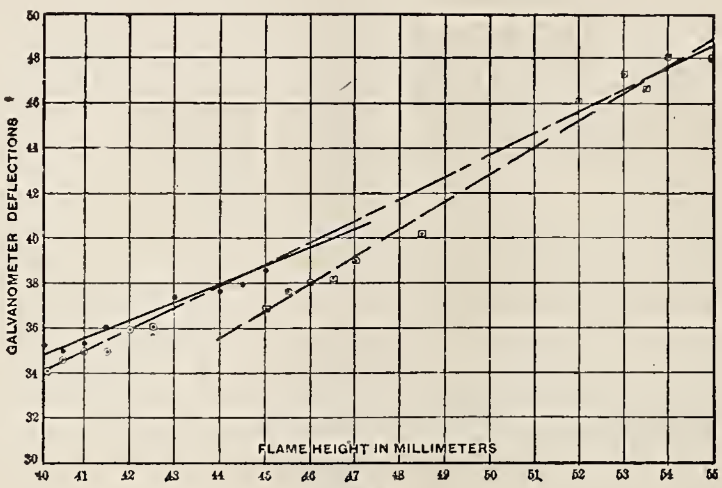


Fig. 8

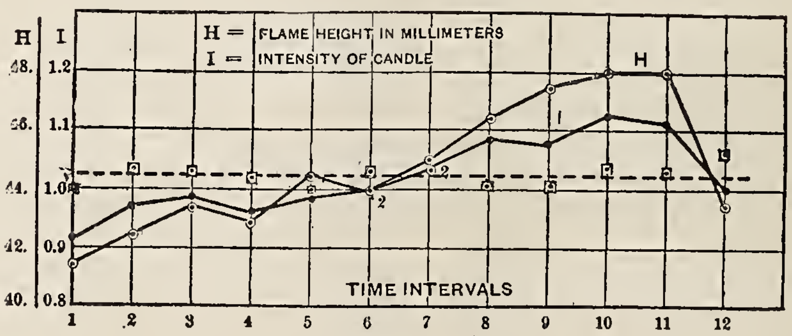


Fig. 9.

English candle is subject to sudden variations in intensity, which are sometimes as large as 15%. Many of these sudden drops were noticed while making the photometer observations, and they all had the same characteristics as are shown by the bolometer curves. Fig. 9 shows a group of these observations—group F in the tables. Assuming that the time intervals between the various photometer settings were equal, points were plotted showing the relation between intensity of the candle and time, and between flame height and time. It will be seen at once that the two curves are of very similar character. The flame height gradually increased, and with it the intensity, until, when the height of 48 mm. had been reached, there was a sudden drop, the change in intensity mounting to 12%. These curves evidently show in an imperfect way variations precisely similar to those which are so faithfully reproduced by the galvanometer needle. In view of these qualitative and quantitative results, it would seem to be impossible to doubt the reliability of the bolometer as an instrument for making such tests.

(To be continued.)

Welding Metallic Bodies.—The welding of metallic bodies by means of simple pressure at temperatures far below their fusing point has, says the Boston "Journal of Commerce," attracted much attention. The plan is to put the metal in the shape of cylinders bounded by plain surfaces, special care being taken as to their purity, they having been mounted and welded together by means of a hand screw, are placed in a heating oven and kept at a temperature of between 200° and 400° for from three to twelve hours. The results show that the most perfect joints are produced with gold, lead and tin; while the most adverse are with bismuth and antimony. Two cylinders thus welded together can be put in a lathe, one of them only being held in the chuck, while the other is being worked upon by a cutting tool, without coming apart, and though they can be separated by the aid of pincers a rough breakage is thus produced, which does not coincide with the original plane of separation. It appears, too, that the more crystalline the bodies, the less is this phenomenon of incipient liquefaction exhibited, the commencement of its appearance in the case of platinum, for instance, being, as represented, some sixteen hundred degrees below the fusing point, that such a liquefaction or softening actually takes place being abundantly proved.—Modern Progress.

To Stop Bleeding.—Mr. Lawson Tait has invented an electrical hemostat, an instrument whereby the electric current is applied for the arrest of bleeding. The principle of the instrument is the generation of heat, by the resistance to the current offered by certain metals, and the coagulation of all albuminous tissues by temperatures at or above 180° F. A platinum wire is inclosed in the blades of a pair of steel forceps, or any other requisite instrument, the wire being isolated by a bed of burned pipeclay. A current of suitable voltage is turned on, the artery seized and compressed, and in a few seconds its tissues are so coagulated and its walls agglutinated that further passage of blood is rendered impossible. The necessity for a ligature is thus removed, and a new and completely effective method is placed in the hands of the surgeon for the treatment of surface oozing.—Boston Transcript.

Interesting Facts in Science.

Walking 85,930 Miles an Hour.—Have you ever thought of the distance you travel while you are out for an hour's stroll? Possibly you walk three miles within the hour, but that does not by any means represent the distance you travel. The earth turns on its axis every twenty-four hours. For the sake of round figures we will call the earth's circumference 24,000 miles, and so you must have traveled during your hour's stroll a thousand miles in the axial turn of the earth.

But this is by no means all. The earth makes a journey round the sun every year, and a long but rapid trip it is. The distance of our planet from the sun we will put at 92,000,000 miles. This is the radius of the earth's orbit—half the diameter of the circle, as we call it. The whole diameter is, therefore, 184,000,000 miles, and the circumference, being the diameter multiplied by 3.1416, is about 578,000,000.

This amazing distance the earth travels in its yearly journey, and dividing it by 365 we find the daily speed about 1,584,000. Then, to get the distance you rode round the sun during your hour's walk, divide again by 24, and the result is about 66,000 miles. But this is not the end of your hour's trip. The sun, with its entire brood of planets, is moving in space at the rate of 166,000,000 miles in a year. This is at the rate of a little more than 454,000 miles a day, or 18,900 miles an hour.

So, adding your three miles of leg travel to the hour's axial movement of the earth, this to the earth's orbital journey, and that again to the earth's excursion with the sun, and you will find you have traveled in the hour, 85,930 miles.—N. Y. Dispatch.

Electric Heater for Oil Wells.—An electric heater has been devised for use in oil wells, which it is hoped will make used-up wells as good as new. The common theory as to exhaustion of so many wells is that the oil, in passing upward through the stone, has clogged the porous stone with paraffine in such quantities that the further flow is stopped and the well ceases to produce. Some think that it is because the supply in the earth has given out, but the generally accepted idea is that the oil is still in abundance, and only ceases to flow when the exit is stopped. The stone through which the oil passes is of a very porous nature, and as the liquid is in a crude state, the thick matter becomes as dregs, settling in the rock near the edges of the bottom of the well. It has been common to use torpedoes to shatter the stone at the bottom of the well, thus breaking up the clogged matter, but this is an expensive process. The electric heater melts out the paraffine and restores the original conditions.

Chemical Process of Exhausting Incandescent Lamps.—It is stated that most of the lamp manufacturers in Germany are now using chemical processes in conjunction with the air pump for exhausting incandescent lamps. A piece of armorphous red phosphorus is placed within the tube connecting the lamp with the exhaust pump. The tube is gently heated while the pump is acting, and when carried sufficiently far the current is gradually raised to about three times the normal voltage and then reversed frequently. When blue light fills the globe the tube is sealed off, so that the lamp tube still contains the phosphorus. The operation is then repeated until the blue light disappears, leaving a light brown deposit on the glass. An experienced workman is said to perform the entire operation in about two minutes.—Philadelphia Record.

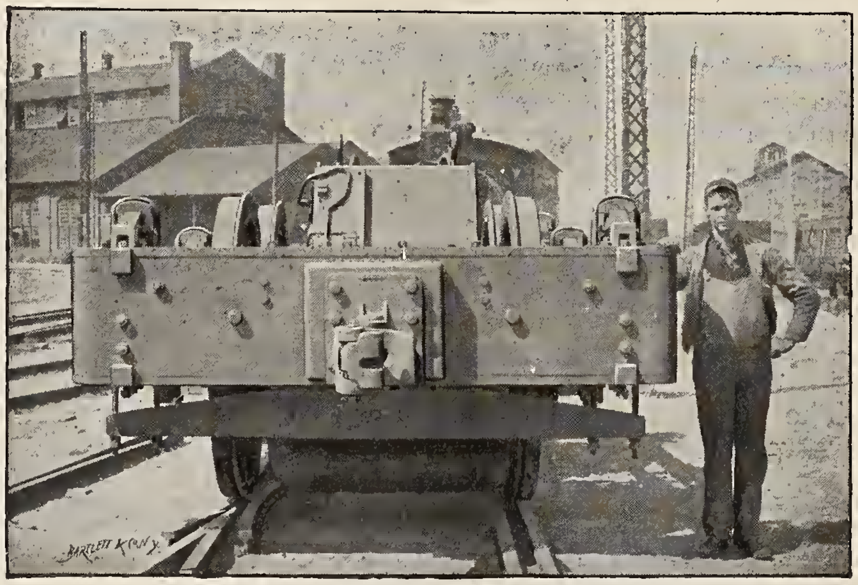
Air Ships.—Professor Bell, the inventor of the telephone, takes quite an interest in air ships. According to him, the proper method of propelling the ship would be a trolley in which the rod would hang down to the feed wire instead of extending upward, as it usually does. He is reputed as declaring that the time occupied by inventors in working out the problem of aerial navigation by the use of gas-bag methods is time wasted.—Bangor Journal.

ELECTRIC RAILWAYS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

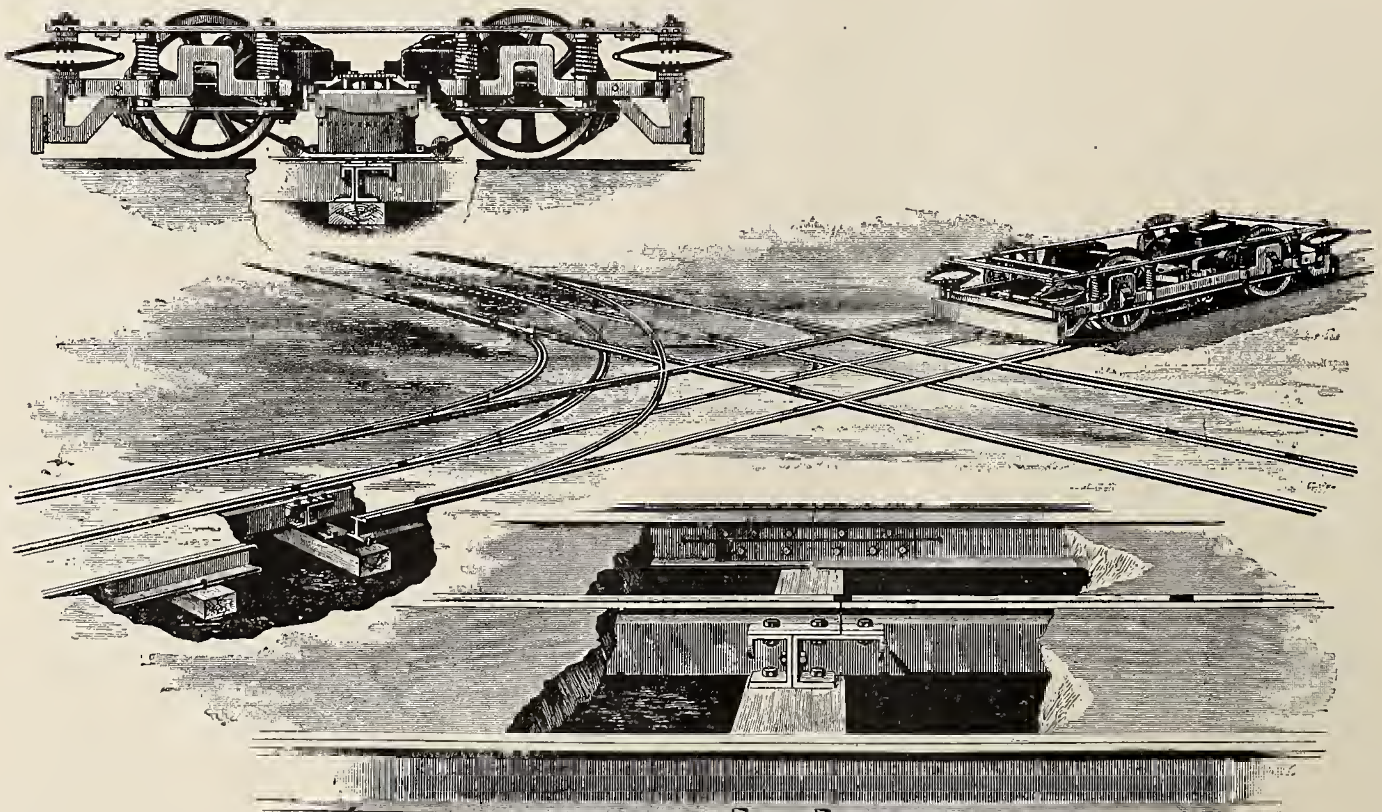
BY NEWTON HARRISON, E. E.

Many systems of railroading have been attempted in this country. The labors and extensive experiments of



A HEAVY ELECTRIC RAILWAY TRACK.

Siemens in Germany, Edison, Daft and Sprague of America, were not always crowned with success. The difficulties that beset the path of the inventors, the poorness in one sense, of the mechanism, and the difficulty of obtaining the proper materials, greatly prevented them from progressing with any rapidity. The result of their efforts has been, as we well know, very successful from a



MCLAUGHLIN CONDUIT SYSTEM.

practical standpoint. The electric railway of to-day is but part of a vast system that will replace all else and whose lines will reach from the Atlantic to the Pacific. The systems of railroads that have been tried with more or less satisfaction are contained in the following list:

SYSTEMS:

The Trolley,
Conduit,
Block,
Storage battery.

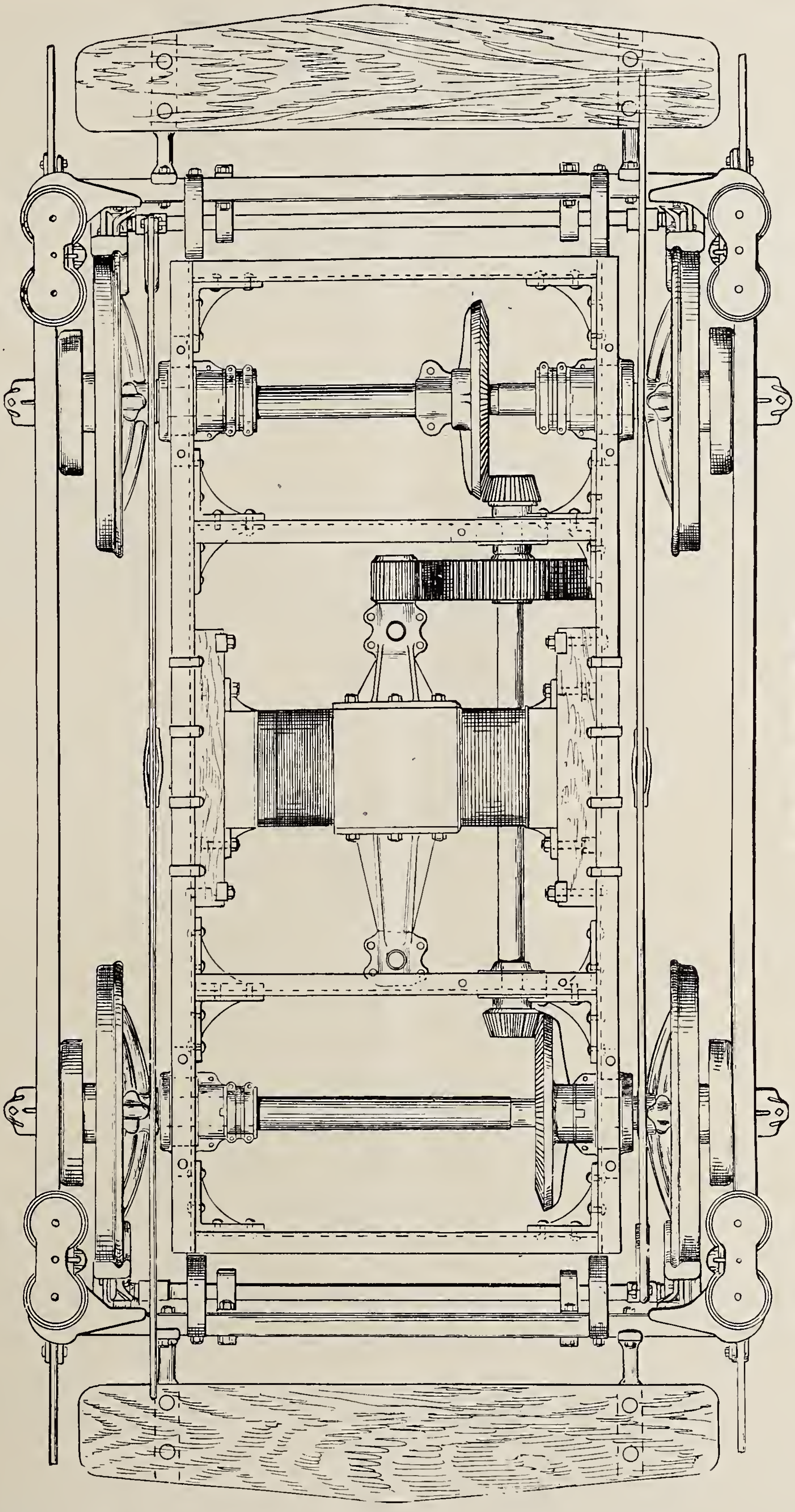
STORAGE BATTERY CARS.

Several combinations of the above have occurred, such as a block-storage battery system of Johnson and Lundell. A method once suggested was that of having steam and dynamo plant on the train and feeding direct to the motor beneath. This was thought far superior in efficiency to the use of a steam locomotive whose record of usefulness does not exceed 4%. The diversity of opinions existing relative to the gain and excellence of different systems hardly exists at present. The storage-battery traction method would be first-class if the storage battery were not so heavy, less troublesome to handle and a little more efficient in delivery of power. The trial made with these cells and other hybrid types has been in this city, at least, without other than temporary success. The trolley, conduit and block systems carry only the motor, but the storage battery car moves along dragging at the same time a ton or more of cells. These cells do not pay any fare and necessitate extra contrivances for their hasty transfer from car to station or the converse. Many managers of bankrupt companies could supply eloquent testimony in relation to the subject.

CONDUIT.

Germany has enjoyed the privilege of having within its

confines one of the few successful open conduit electric roads in the world. It had the first. The desire to emulate the example of German engineers caused several subscriptions in that direction which in this country until last year signally failed. The development of a railroad scheme having a conduit road as its basis was looked upon as impossible. An open slot cable conduit differs in no particular from the cavity used for electrical purposes. Two conductors, insulated as carefully as possible and protected from the drippings that might corrode and injure them, are laid within side by side. A trolley wheel, slide or equivalent arrangement takes current from the wires to the motor above.



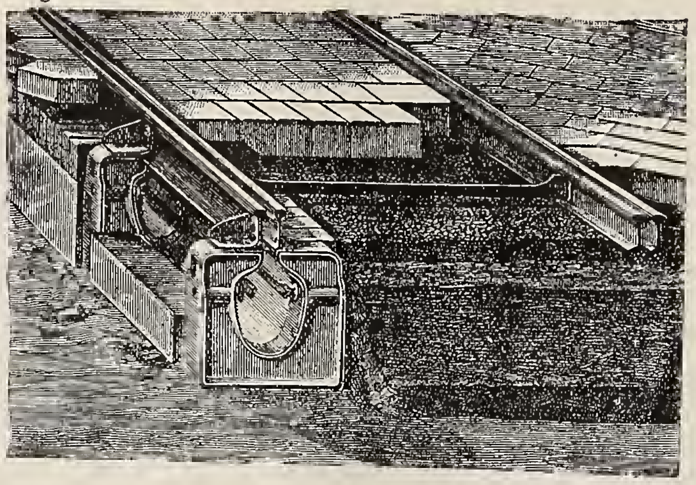
PLAN OF MOTOR WITH GEARING.

As far as the running of the system is concerned, it has proven a success. The financial end is not open for public inspection. The travelers who employ the car

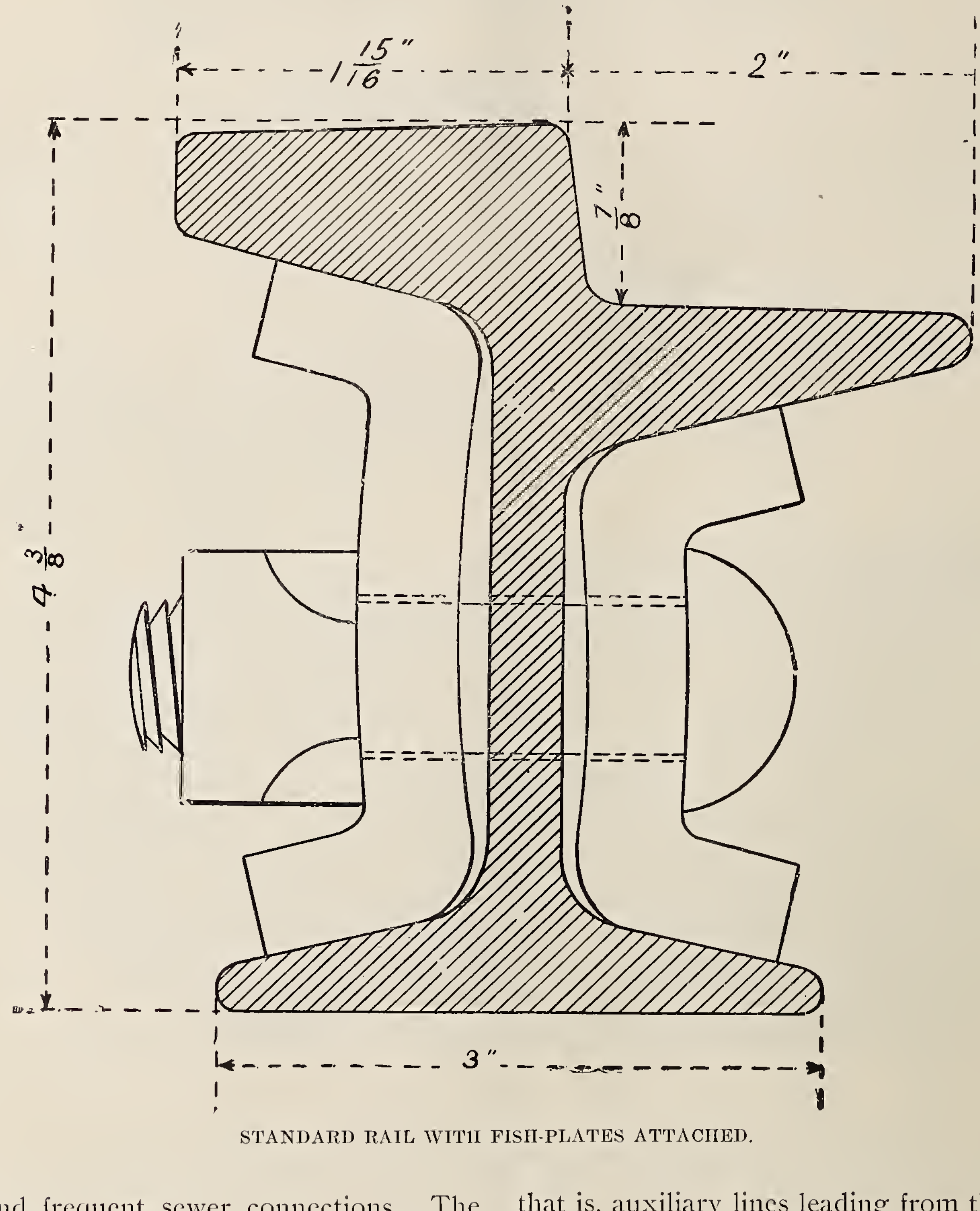
from point to point express satisfaction, so that from a popular point of view the road is all right. The future of this road embraces that of many others. The trolley is dispensed with and the wholesome objections of municipal authorities to all external appliances. The leakage within the conduit may be brought to a minimum by having large, open and frequent sewer connections. The drainage is thus rapidly removed, and the only loss of power is that due to the moisture and condensation on the exposed wires and their supports.

DROP OF POTENTIAL.

It is necessary to appreciate the fact that the loss from leakage and the drop of potential seriously interferes with



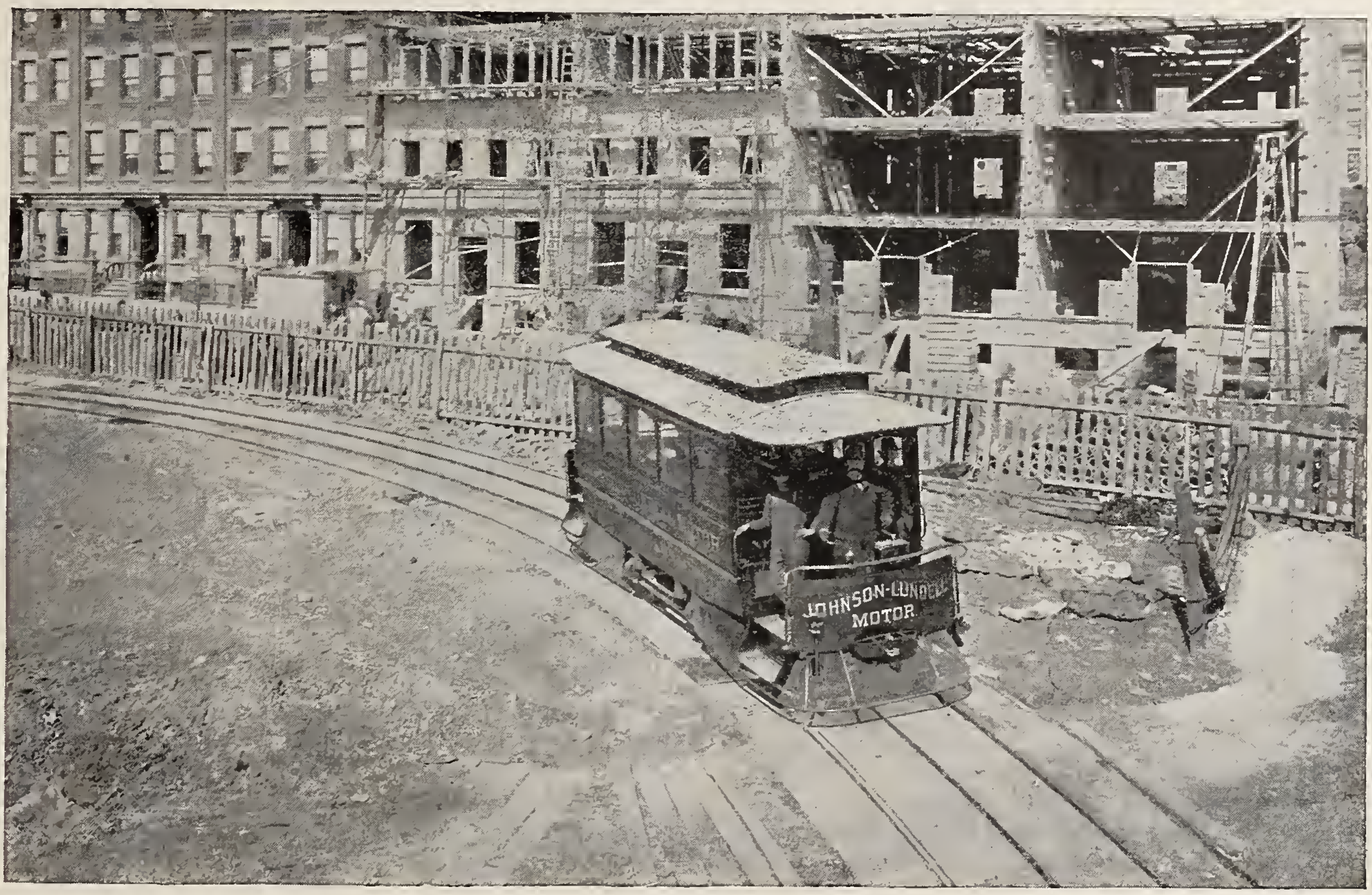
OPEN CONDUIT SYSTEM.



STANDARD RAIL WITH FISH-PLATES ATTACHED.

the efficiency and growth of a line. The leakage may be reduced by careful insulation, but the loss of pressure only by a successful and necessarily practical method of joining the parts entering into the circuit. The circuit in an open conduit system is two continuous copper wires or something similar reinforced by a system of *feeders*, that is, auxiliary lines leading from the dynamo room or station to different points of the line. When a set of cars take current simultaneously from the circuit a heavy flow of current ensues. The drop of potential, calculated by the rule—drop equals current multiplied by resistance—may vary from 50 to 150 volts or more. In trolley lines the tracks being part of the circuit must be electric-

ally joined or *bonded* together. The overhead line or trolley wire is the remainder of the circuit. By having the tracks or rails welded or at least carefully joined the drop of potential is greatly reduced and the system in-



JOHNSON-LUNDELL SYSTEM.—Storage Battery Block.

finitely improved. In trolley lines careful attention to these points will mean a saving of thousands of dollars in installation and running.

English Progress.—The first horseless carriage ever used in England was made and run on common roads in Great Britain as early as 1827. The conservative tendencies of the British people appear to have been the only obstacle to developing the horseless carriage for common roads about the time that railroads were coming into existence, but our English friends hated innovations, and laws were passed prohibiting the running of horseless carriages on the public highways. It remained for the French seventy years later, to begin demonstrating the usefulness of horseless carriages, and now the English people are becoming aware of the race they have lost by their conservative tendencies. A new act of Parliament has been passed giving horseless carriages some privileges on the public highways, and the horseless carriage is beginning to make its way in England. With the splendid roads they have got over there it is likely enough that within a few years, carriages driven by petroleum, by gas, or by light steam engines, will be second only in popularity to the bicycle. So far, the most successful horseless carriages have been driven by steam and petroleum, but the prospects for electricity as a motive power seem to be very fair. It suffers from the drawback of requiring storage batteries, and this makes the load too heavy. Most of the carriages hitherto tried have been merely horse carriages equipped with power. The likelihood is that, in developing this form of vehicle, people will depart as far from the ordinary horse carriage as they have done in making vehicles for railroad use.—Locomotive Engineering.

Albert C. Jahl, the genial electrical supply man, No. 39 Cortlandt street, New York, is just the same Jahl as ever. He is getting his share of business regardless of the hoodoos in the trade who do nothing but hide and howl at such a time. Mr. Jahl in one morning this week sold three large power motors and a complete electrical equipment for a 300-light plant. Mr. Jahl is a general agent and handles all kinds of electrical goods. His offices have just been remodeled and recarpeted. The addition of a beautiful oak roll-top desk makes it one of the neatest reception rooms in the city.

Mr. Straschnow and Mr. Frorup, the direct representatives of the firm of Schiff, Jordan & Co., of Vienna, have opened a fine suite of offices at No. 39 Cortlandt street, New York. They will show samples of arc lamp carbons superior to any other line now on the market. Mr. Frorup's name in connection with this line is in itself a guarantee of their superiority. These carbons are not new in this country; they have been in use in small quantities. In every case their excellence and great duration of life, their complete combustion, absence of deposits and brilliant light have won admiration from all sides. Write to Mr. Ralph Straschnow, the general manager, for further particulars.

SCHIFF, JORDAN & CO.

We take pleasure in informing you that we have opened our own office, and are now bringing to this country a brand of carbons for alternating and direct-current superior to any we have previously produced, and do not hesitate to say that these carbons are better than any other now on the market.

We enclose you herewith our price-list and shall be pleased to quote our best discount. We shall also be pleased to furnish samples, free of charge, to any intending purchaser; and wish particularly to call your attention to the fact that our prices are lower than any you have previously been given.

We shall at all times have a full assortment in stock, and all orders will receive prompt attention.

Trusting to hear from you, we are, yours very truly,

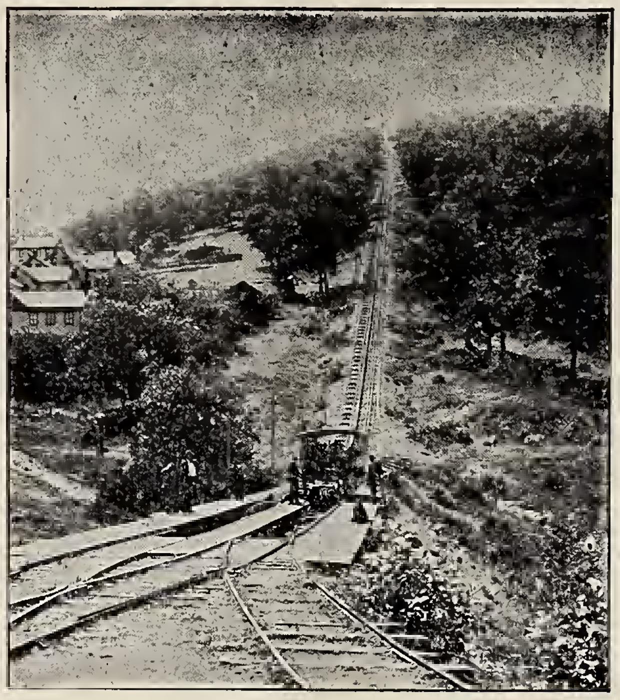
Schiff, Jordan & Co.

Nos. 39 and 41 Cortlandt street.

South Orange, N. J.—The streets of South Orange will be lighted by incandescent lamps after Sept. 1. They have been lighted with gasoline lamps.

A GREAT PANORAMA.

Governor De Witt Clinton in 1820 wrote a series of letters signed "Hibernicus," describing the great lake regions of Seneca, Cayuga, Owasco, Canandaigua, Hemlock, Cazenovia and Oneida. The great and winsome beauty, the unparalleled landscapes and picturesque glens show a touch of nature rich in its unbroken charm, unexcelled in rural elegance. The Land o' Lakes is truly a crystallized dream within the easy touch of the city horde.



MOUNT PISGAH PLAIN SWITCHBACK RAILROAD.

MUSCONETCONG TUNNEL.

Jump on the Lehigh Valley train and pass swiftly through this land of promise, with its enchanting scenery, its hazy vistas of flower and field, of mountain and dale.

The great lines of tracks shining in the brilliant sun, the well-kept roadbed, have well given to the Lehigh Valley the name of being America's cleanest railroad.

The pretty catalogue issued by them is written in all modesty and quickly answers the questions flying to every tourists' lips. Read its first page and your interest will lead you to desire the rest:

"This brochure is designed to acquaint the travelling public, patrons of the Lehigh Valley Railroad, with the scenic attractions, cities and towns on its line between the seaboard and the great lakes, as seen from the windows of its elegantly equipped and fast moving trains.

"It will, as a matter of course, not enter into an extensive historical exposition of the municipalities, nor draw elaborate pen pictures of the many scenic beauties that lure many thousand annually into their delightful confines, but it will, in a concise way, point out what we believe would be the answer to leading questions by the traveller or tourist passing over the route."

If the anticipation lacks in one iota the fulfilment, then we may say the land has changed its garments, the sky its color, the lakes their soft and liquid freshness.

WALKER CO., CLEVELAND, O.

Among recent orders received may be mentioned incandescent lighting machines, as follows:

Two 100-K.W. and one 50-K.W. direct-connected, multipolar generators for Murray Hill Hotel, New York City, and switchboard complete

Two 75-K.W. direct-connected multipolar generators for Windsor Hotel, New York City.

One 50-K.W. direct-connected, multipolar generator and switchboard for Cochin, China.

Railway Generators as follows:

Six 800-K.W. special rope-driven, multipolar generators and switchboard for Chicago City Railway Company.

Four 200-K.W. direct-connected mutipolar generators for Englewood & Chicago Railroad (storage battery road).

One 400-K.W. direct-connected multipolar generator for London Street Railway Company, London, Ontario.

One 300-K.W. direct-connected multipolar generator for Pacific Power Company, of San Francisco, Cal.

Two 150-K.W. direct-connected multipolar generators and switchboard for Albion Construction Co., Chicago, Ill.

One 1,200-K.W. direct-connected multipolar generator for Metropolitan Street Railway Company, of Kansas City, Mo.

Two 400-K.W. direct-connected multipolar generators and switchboard for Brooklyn Bridge.

One 800-K.W. direct-connected multipolar generator and switchboard for Albany Railway, Albany, N. Y.

Two 800-K.W. direct-connected multipolar generators and switchboard for Syracuse Street Railway Company, Syracuse, N. Y.

CANADIAN LETTER.

Quebec, Que.—The Electric Railway Company propose to commence the construction of the road at an early date.

Thorold, Ont.—The company that intends building an electric railway between Hamilton and Niagara Falls, will build a power-house on the site of the Morning Star grist mill, at Decew's Falls.

Hamilton, Ont.—The shareholders of the Hamilton and Dundas railway have approved of the conversion of the road into an electric line.

Ottawa, Ont.—An electric railway is proposed to run between Richmond and Ottawa.

Cornwall, Ont.—The prospects of the Cornwall Electric Railway are good. It carried 10,000 people on a recent holiday.

Cobourg, Ont.—The Canadian Electric Railway and Power Company seeks power to build an electric railway from Cobourg, via Port Hope, Bowmanville, Oshawa, Whitby, Toronto, Oakville and Hamilton, to Suspension Bridge and Niagara Falls.

Montreal, Que.—The Montreal Park and Island Railway Company purpose erecting two new power-houses, one at Lachine and the other at St. Laurent. The plans are now in course of preparation.

Hamilton, Ont.—M. F. G. Beckett, the promoter of the Hamilton, Chedoke and Ancaster Electric Railway, is said to have secured the necessary right of way, and steps will be taken at once to complete the organization of the company.

Hamilton, Ont.—Negotiations are still pending for the conversion of the Hamilton and Dundas Railway into an electric road.

Sistowell, Ont.—The Sistowell Gas Company will probably put in an electric plant.

Owen Sound, Ont.—The Owen Sound Electric Light Company will enlarge their plant to supply power.

St. Thomas, Ont.—The City Council will submit a by-law to the ratepayers for the establishment of a city electric light plant.

Peterborough, Ont.—The Auburn Light and Power Company has been organized here. The promoters are Messrs. James Kendry, M. P.; John Carnegie and W. H. Mebdrum. The company will supply light and power.

Ottawa, Ont.—M. J. R. Booth will place two arc machines in his electric light plant at his saw-mill.

Brantford, Ont.—The Brantford Electric Light Company will put in new machinery, to cost $25,000.

Toronto Junction, Ont.—The City Council is going to buy a new 40-light dynamo.

Prescott, Ont.—The electric light company contemplate adding to their plant.

Winchester, Ont.—It is probable that the local authorities will install an electric light plant here.

Shubenacadie, N. S.—A gentleman from Halifax is considering the question of installing an electric light plant here.

Brockville, Ont.—An electric light plant for the asylum will probably be installed.

Huntsville, Ont.—Mr. Vaughan, Mr. Roberts, C. E., of St. Catharine's, have prepared plans and specifications for an electric light plant and the work will shortly be advertised.

Port Arthur, Ont.—The Port Arthur Pulp Timber Company is being incorporated to manufacture timber and to construct electric light and power works. The capital stock is $200,000.

J. Alcide Chausse.

POSSIBLE CONTRACTS.

Youngstown, O.—The Lloyd-Booth Co. is making a new addition to its plant, which is to be used as a machine shop.

East Lafayette, Pa.—$50,000 is being expended in improvements on the Riverside PaperMills' plant by W.C. Hamilton & Sons, proprietors.

Boston, Mass.—Plans have been made and approved for the erection of a six-story mercantile building at the southeast corner of Massachusetts avenue and Dundee street, for Meyer & White, builders and contractors. The plans are by A. A. Meyer & Co. The estimated cost of the building above the ground is $155,000. It will be warmed by steam and equipped with elevators.

Bamberg, S. C.—An election was held to decide whether the town of Bamberg should be bonded for an electric light plant. Negotiations are now being made with the electrical concerns to furnish the plant. It is proposed to light the streets with thirty arc lights and furnish 500 incandescent lights for private purposes.

South Orange, N. J.—The plans and specifications for the new power station of the Peoples' Light and Power Company are in the hands of the contractors for estimates.

NEW CORPORATIONS.

Philadelphia, Pa.—A charter was granted to the Southwark Motor Company, of Philadelphia. Incorporators, Benson W. Conrad, Emily F. Conrad, Charles F. Temple, Jacob F. Potter, Robert A. Potter, and Samuel P. Lukens, all of Philadelphia. Capital stock, $25,000.

St. Louis, Mo.—The Long-Distance Electric Typograph Company has been incorporated by J. J. Reifgraber, J. Handelman, C. P. Connolly, C. Lenz and J. Friedman. Capital stock, $100,000.

Seattle, Wash.—C. P. Tatro, A. F. Nichols, L. B. Stedman and B. A. Knapp have filed articles of incorporation of the Electric Reduction Company. Capital stock, $300,000. To carry on a general mining and electric reduction business.

San Francisco, Cal.—The Peninsula Lighting Company has been incorporated by John E. Howard, Oliver Ellsworth, Edwin Fish, T. F. Laist, and John E. Jones. Capital stock, $200,000, of which $57,500 has been subscribed.

TELEPHONE NOTES.

Baltimore, Md.—The Standard Telephone Company, of Baltimore, is arranging for the establishment of an enlarged telephonic system. A number of the larger penin-

sula towns have already been provided with the new system, and it is proposed that Crisfield, Pocomoke City, Salisbury, Delmar, Laurel, Easton, Centreville, and Chestertown shall be connected. The line will be run from Chestertown to the narrowest part of the Chesapeake, and an insulated wire run across the bay and thence to Baltimore.

Indianapolis, Ind.—The Kurtz National Telephone Company is asking for a franchise permitting it to operate a competitive telephone system in this city. The company propose to make a rate of $2 a month for residences and $3 for business places.

Bangor, Me.—The New England Telephone and Telegraph Company is laying a submarine cable. The cable is 1,500 feet long and extends from the shore near Waukeag station in Sullivan across to Hancock.

St. Joseph, Mo.—A suit has been filed by D. Ransom asking that a receiver be appointed for the Citizens' Telephone Co.

Cisco, Tex.—A telephone exchange is being put in by Frank Vernon.

Albion, N. Y.—An automatic telephone system will soon be installed in this city.

Shelbyville, O.—The Shelby County Telephone Company has increased its capital stock from $10,000 to $35,000.

Milwaukee, Wis.—The Appleton telephone system is being thoroughly overhauled and extensive improvements in the system are promised for next season.

TELEPHONE PATENTS.

Jefferson City, Mo.—The Standard Telephone Co., of Kansas, has been incorporated by E. G. Fish, J. S. Welsh, D. T. Morton and others. Capital stock, $300,000.

Albion, N. Y.—The Citizens' Telephone Company has been incorporated by G. T. S. Foote, A. C. Burrows, P. W. Collins, and others. Capital stock, $5,000; to conduct a telephone business in Albion, Orleans County.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued July 28, 1896.

564,584. Motor Vehicle. Charles H. Barrows, Willimantic, Conn. Filed July 6, 1895.

564,629. Electrical Propulsion of Canal Boats. Alonzo C. Mather, Chicago, Ill. Filed Dec. 1, 1893.

564,632. Electric Car Brake. Andrew W. Mitchell, Winthrop, Mass. Filed Sept. 19, 1895.

564,638. Trolley Finder. Harrison Ogborn, Indianapolis, Ind. Filed Jan. 13, 1896.

564,642. Igniting Device for Gas Engines. Andrew J. Pierce, Racine, Wis. Filed May 27, 1893.

564,652. Paste-Carrying Plate for Electric Accumulators. Friedrich W. Schneider, Triberg, Germany. Filed May 2, 1896.

564,679. Back Connection for Switchboards. Alexander J. Wurts, Pittsburg, Pa. Filed Nov. 7, 1895.

564,683. Electric Railway Signal. William Daves, Jersey City, N. J. Filed April 22, 1896.

564,702. Alternating Current Generator. Benjamin G. Lamme, Pittsburg, Pa. Filed April 30, 1894.

564,703. Alternating Current Generator. Benjamin G. Lamme, Pittsburg, Pa. Filed June 30, 1894.

564,717. Electrical Soap. Herbert E. Rider, New York, N. Y. Filed Oct. 8, 1895.

564,723. Incandescent Electric Lamp Fitting. Eugene F. A. Soleau, Paris, France. Filed March 19, 1896. Patented in France Aug. 3, 1893; in Belgium, Feb. 5, 1894; in England, Feb. 8, 1894, and in Germany, Feb. 14, 1894.

564,743. Dynamo-Electric Machine and Electric Motor. William B. Elliott and John W. Eskholme, Westfield, N. J. Filed Aug. 26, 1895.

564,746. Annunciator. Claude C. Gould, Buffalo, N.Y. Filed Sept. 28, 1891.

564,757. Cut-Out for Arc Lamps. Austin H. Lucas, Pittsburg, Pa. Filed April 4, 1896.

564,771. Electric Arc Lamp. William C. Armstrong, New York, N. Y. Filed Aug. 29, 1895.

564,772. Electric Arc Lamp. William C. Armstrong, New York, N. Y. Filed Aug. 29, 1895.

564,792. Electric Metal-Working Apparatus. Hermann Lemp, Lynn, Mass. Filed Nov. 25, 1892.

564,811. Secondary Electric Clock. Jasper H. Wilson, Rockwood, Tenn. Filed Jan. 9. 1896.

564,858. Electric Metal Separator. Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, O. Filed Nov. 8, 1895.

564,859. Electric Metal Separator. Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, O. Filed Nov. 8, 1895.

564,861. Electric Rack Locomotive. David L. Barnes, Chicago, Ill. Filed March 19, 1896.

564,907. Electric Arc Lamp. Barton B. Ward, New York, N. Y. Filed Feb. 15, 1893.

564,944. Electric Transformer. Frank L. Sessions, Fort Wayne, Ind. Filed Sept. 28, 1895.

564,951. Electric Current Regulator and Distributer. Arthur H. Washburn, Brockton, Mass. Filed May 22, 1896.

The Electrical Age.

VOL. XVIII., No. 11. NEW YORK, SEPTEMBER 12, 1896. WHOLE No. 487

The Riker Electric Carriage.
(By courtesy of "The Electrical Engineer" and "Horseless Age.")

A WINNING ELECTRIC CARRIAGE.

It is interesting to observe the headway being made in the construction of horseless carriages. Mr. A. L. Riker has built a vehicle of this description which undoubtedly has points of superiority over others. The N. Y. "Herald" publishes this account of a trial made for the purpose of establishing this fact:

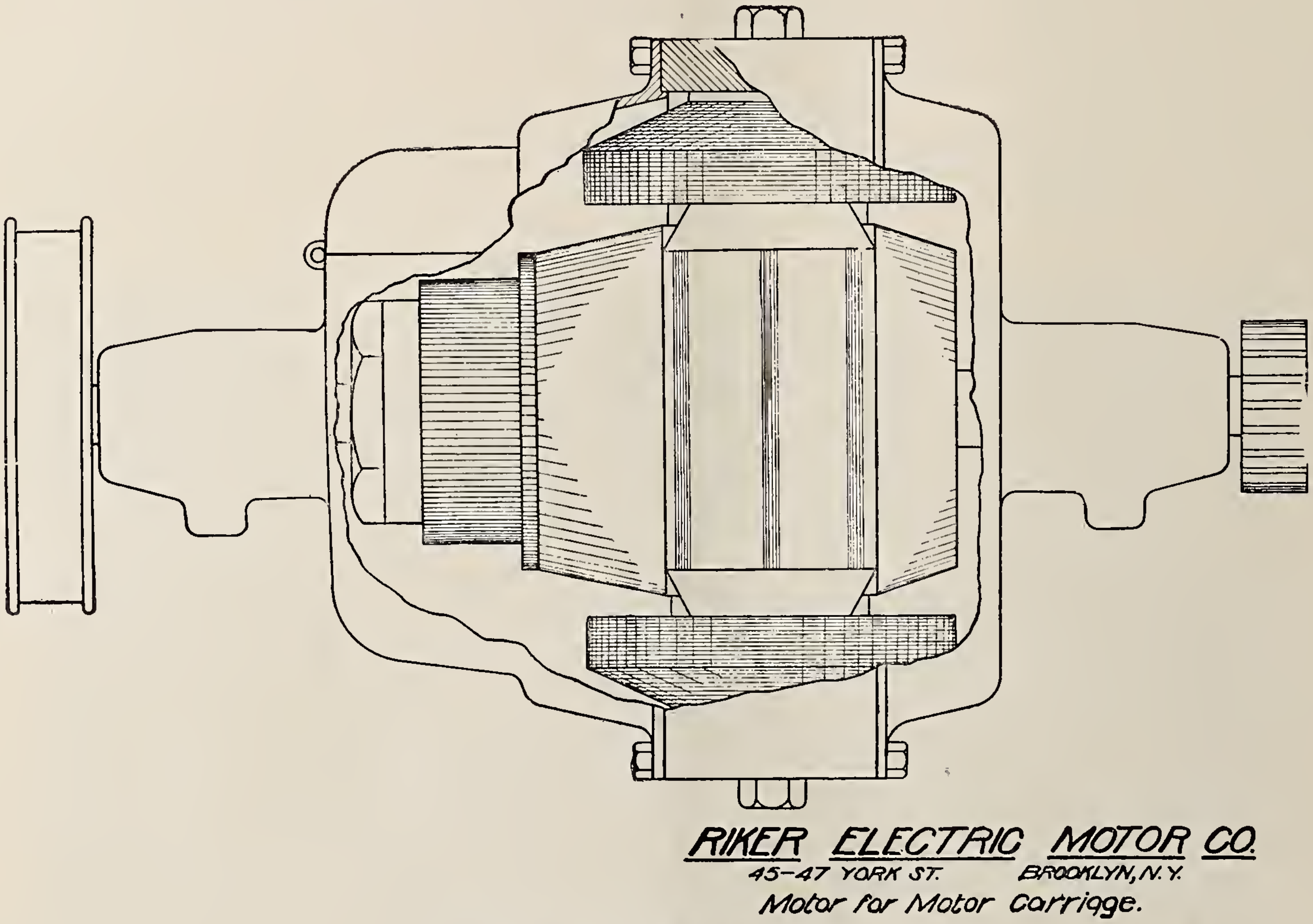
Providence, R. I., Sept. 7, 1896.—The seventy-sixth annual meeting of the Rhode Island State Fair opened today under the most favorable circumstances. Considerable amusement was afforded by a competition between horseless carriages. In a five-mile run the Riker Electric Motor Company was the winner, closely followed by George Henry Hewitt, of Springfield, Mass. There were six other starters, but they were far behind at the finish. Time of first carriage, 15m. 1¾s.

The various carriages were propelled by steam, naph-

tha, etc., yet none were of any avail in the race with Mr. Riker's electric carriage. Each day a five-mile race was run, the Riker carriage winning those of the first two days. If they win three out of five they get the main prize of $2,000. This race was run in the beginning against thirteen others and seven starters. The Riker electric motor is, of course, the driving power of the carriage. The weight of the entire outfit is 1,500 pounds, with reserve space for 300 pounds more, giving a total of 1,800 pounds.

The seating capacity will be sufficient to convenience four passengers, two abreast. In general the carriage is furnished in black. Bicycle wheels are used of substantial make, having pneumatic tires. The Crawford Wheel and Gear Company, of Hagerstown, Md., supplied these necessary parts. The power is supplied by two Riker motors of three horse-power size, gearing individually upon the circular rack of the two back wheels. Every provision is made for protection against dirt, grit and moisture. The motors are enclosed and the other parts likewise. A battery outfit of chloride accumulators of 100 ampere-hours, supply the necessary current. Not only is the carriage propelled by the power of these cells, but it is lit and provided with an electric gong. The cells are so arranged that the rider has at his disposal four rates of speed. These are five, ten, eighteen and twenty-five miles an hour. In addition, this automatic switch or controlling device gives by a turn either progressive or retrogressive motion to the carriage. The exhilaration of a ride on this compact and ingenious vehicle is not easily forgotten. We think the inventor deserves great credit for his success and public victory. The field for these carriages is a broad one. The city would be of the utmost cleanliness if their adoption became general. It is but a little while to wait and then the cable car will have another rival beside the bicycle. It may see its hard-earned dividends melting away like ice on an August day.

St. Louis, Mo.—Work will begin in a few days on the telephone line which will be built here from the North, and which will connect all cities in Greene and Scott counties.

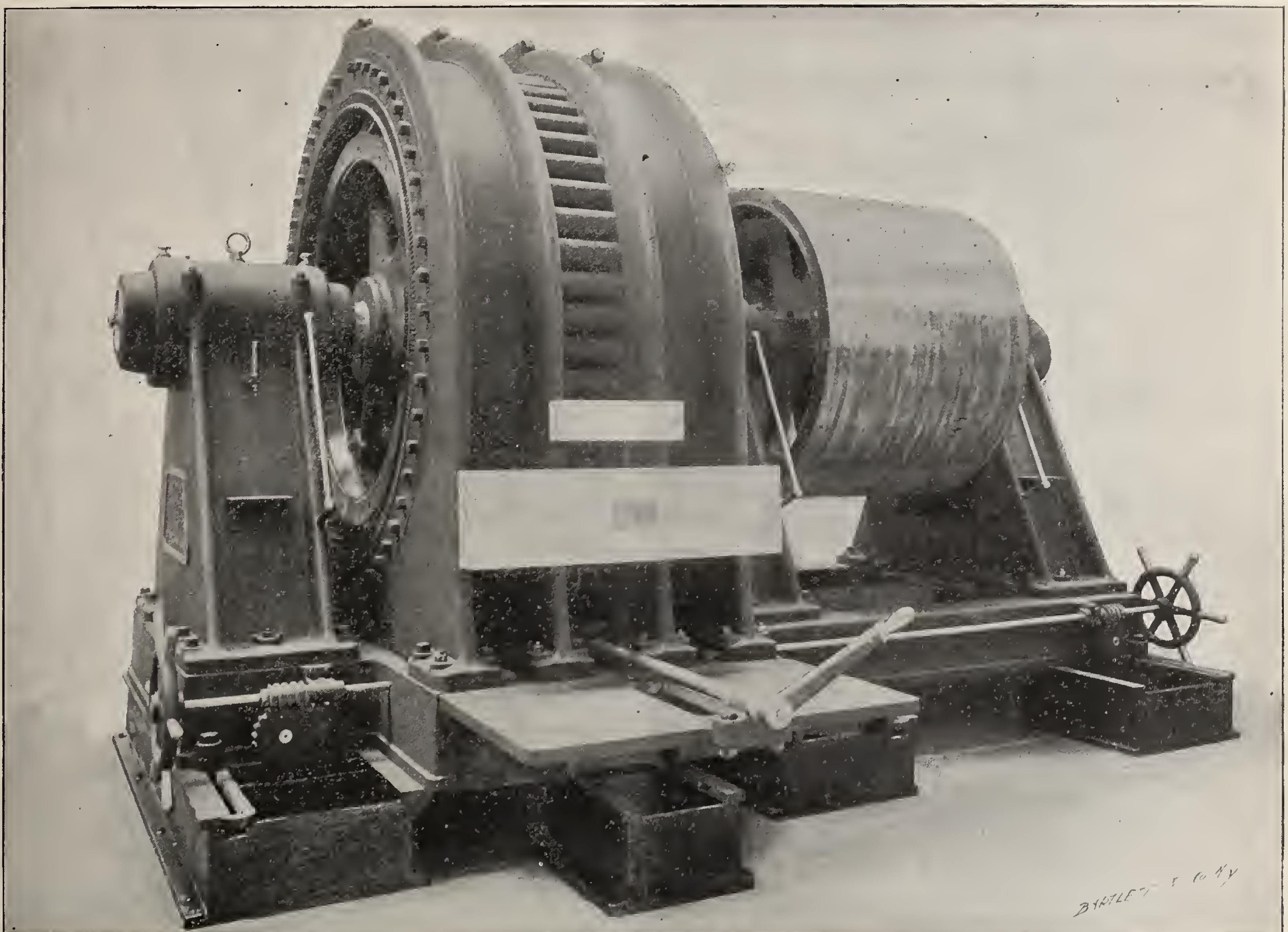


Motor Used For Horseless Carriage.

ELECTROLYSIS SUIT OF OMAHA WATER-WORKS COMPANY.

When suit was brought, nine months ago, against the Omaha Street Railway, by the trustee of the water-works company of that place, for $250,000 damages to the pipes of the water-works system by electrolysis, the interest of the entire street railway fraternity was aroused, as this was the first suit ever brought of such a nature. At first thought it seems rather strange that considering the length of time the damage possible from electrolysis has been known, that some suit should not have been started before. The fact that all has been so peaceful between the electric railway and water-works companies, can only be accounted for by the willingness usually displayed by electric railway managers to remedy the evil, and by the relatively small amount of the actual damage done. But now even the Omaha case has been dismissed by the plaintiffs, an event on which the electric railway industry may justly feel cause for congratulation. The history of this case is as follows, and is one in which both the Omaha and every other street railway in the country may be well satisfied: The Farmers' Loan and Trust Company, which had the water-works in hand, became alarmed by the reports of certain experts regarding the effect of electrolysis on the pipes, and probably honestly believed that they were badly damaged. Suit was brought for $250,000. It was not an easy matter to prove absolutely to the contrary, as the pipes were all buried, and the particular point near one of the power houses, which had not been properly connected, showed damage for a block or more from electrolysis, and had to be relaid, making it look, of course, as if the trouble might soon extend over a large territory. But by great good luck it happened that in compromising some other matters with the city and insurance people, the water-works company agreed to relay with larger pipes nearly all its mains in the business part of the city. This was all done last fall, and, of course, the uncovering of the pipes in all that district which was thickly covered with street railway lines was watched with interest by all parties concerned. Experts from both sides were constantly on hand. The result was satisfactory to everybody, as it was clearly developed that there

was no electrolytic action except at one or two spots, and even there it was doubtful whether it was electrolysis. It was but natural when the water-works people found that they had practically no grounds for damages, that they should ask to have the suit dismissed, as they probably felt that the slight injuries they had sustained could be adjusted without recourse to the courts. The outcome will have a beneficial effect in quieting the fears of many a water-works man, and enabling electric railway managers to "sleep better o' nights."—Street Railway Record.



600-Kilowatt S. K. C. Generator.

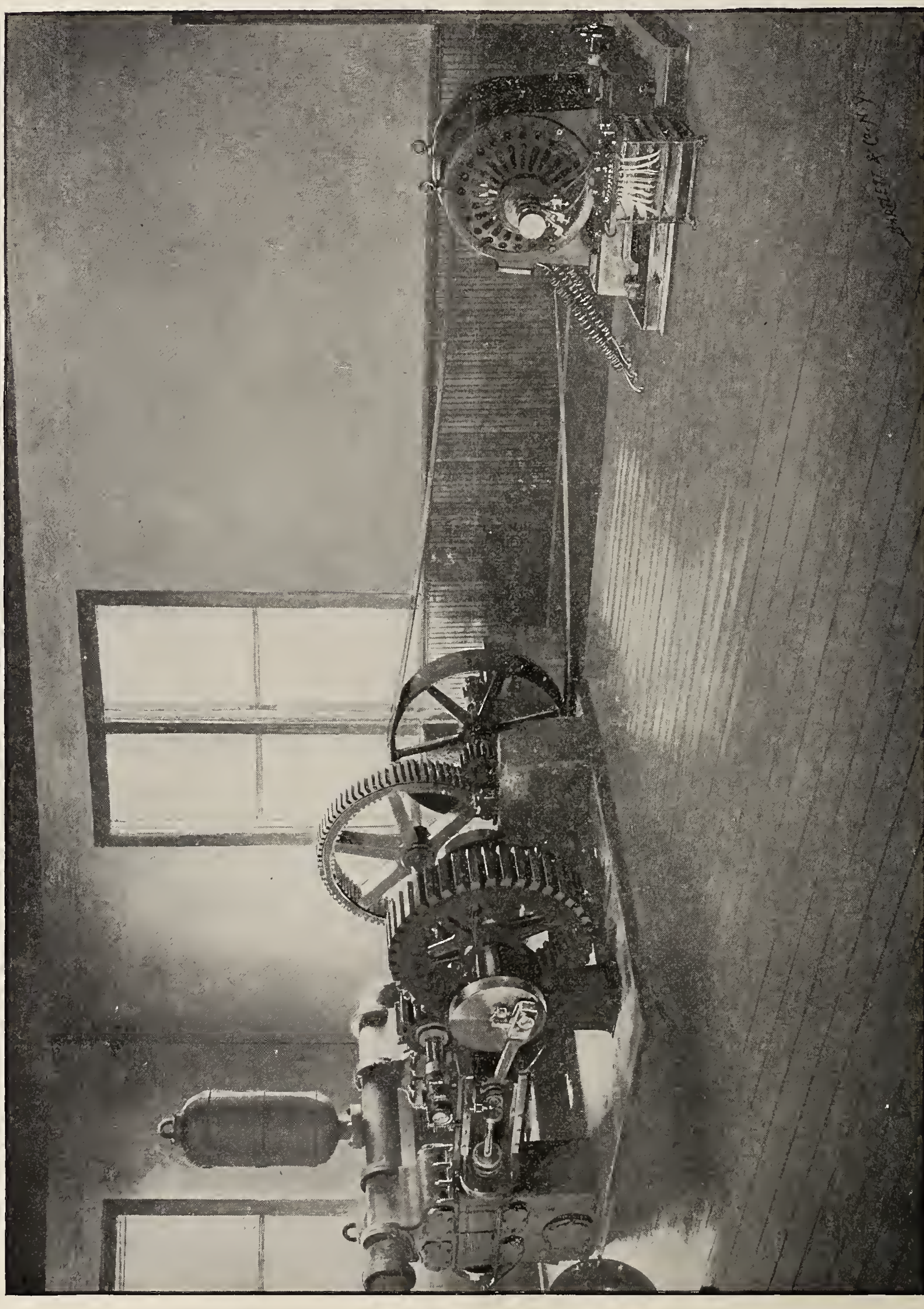
Hysteresis of Steel and Iron.—Dr. Dubois has been publishing some most interesting remarks upon the subject of the magnetizing and hysteresis of various kinds of steel and iron, being based on experiments made by the doctor in conjunction with Mr. E. T. Jones. The doctor states that the distinction of the various kinds of iron by means of their hardness has now quite gone out; the real criterion is rather hysteresis, coercitive power, residual, and maximum and magnetization. The chemical composition of iron is of very little importance compared with the mode of treatment during the manufacture from the ore. The magnetic constants of the material are of great importance to physicists and technologists. Hardening will as a general rule increase hysteresis and coercitive intensity, whereas the residual magnetism is lessened. The cast iron which is manufactured by Krupp is distinguished by its excessively low hysteresis, and the small coercitive intensity which it contains.—Invention.

Literary Note from The Century Company.—Marion Crawford has written a new story specially for "The Century." It is called "A Rose of Yesterday," and it will begin in the November number and run for six months. The story opens in Lucerne, and while it is entirely separate in interest, some of the personages that appear in it will be familiar to readers of "Don Orsino." It is wholly romantic in character.

Testing Quicksand.—Suppose we take a certain quantity of quicksand, dry it artificially, and then try to make it into quicksand again. Put it into a box and pour water on it carefully. Instantly the water is soaked up, and if we measure the volume, or better, the weight of the sand, we shall see that it takes up a quantity of water that measures 30% of its own volume, or 20% by weight. The rest stays above the layer of sand. If we now pierce a little hole in the bottom of the box, we shall see pure water run out; the sand forms a kind of immovable filter. Also by turning the box upside down we see the sand keep its form like a stopper. It follows from this experiment that we cannot obtain quicksand in this way. We must reverse the condition of the experiment. Let us put the water into a vessel and sift in the dry sand in a thin stream, while shaking the vessel lightly. Then we shall get the thick but easily flowing compound known as quicksand. That the mixture may keep its mobility two conditions are necessary: 1. The quantity of water contained must not be less than 21% by weight. 2. The whole must be continually though lightly shaken. If we increase the proportion or interrupt the agitation for an instant, the mass settles down, retaining about 20% of water, while the surplus, if it exists, rises to the top.—La Nature, Paris.

LIGHT AND POWER BY ALTERNATING CURRENTS.

It is many years ago that the first magneto was set in

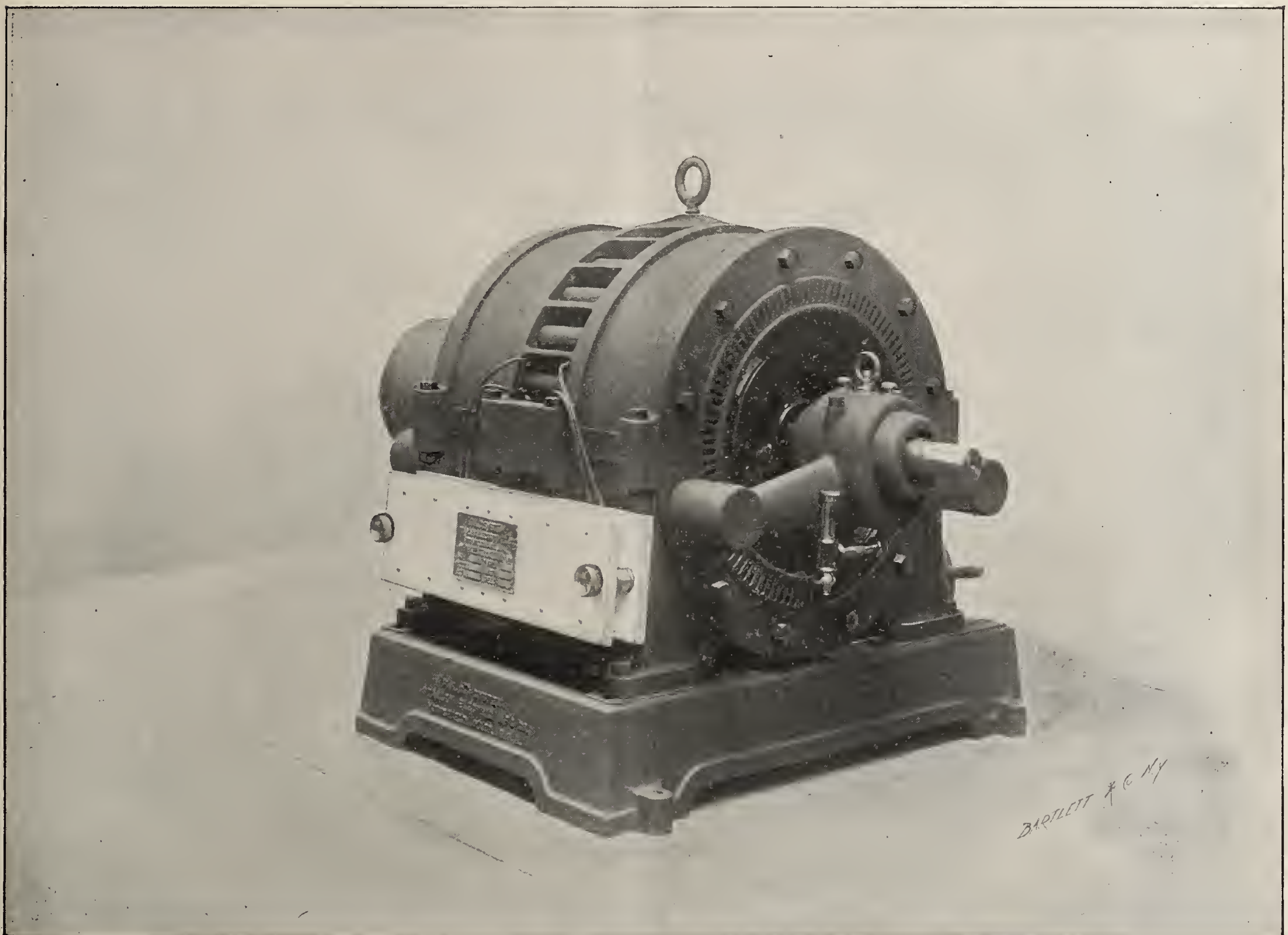


Thirty Horse-Power S. K. C. Motor Driving Pump at Anderson, S. C.

operation. The world has moved on since then. Fortunately the development has not been biased; it has not leaned more in one direction than another. There have been greater demands than ever made upon electrical engineers. Their apparatus is subjected to the closest scrutiny; it is almost as difficult to buy poor dynamos and motors to-day as it was easy to obtain them some years ago. We owe a great deal of our prosperity to the habit we get into of immediately taking advantage of a new and useful idea. Sometimes the idea is rabid, in spite of its apparent worthiness, and the time and labor expended are sorrowfully recalled. These introductory remarks may lead the reader to the point of issue.

The magneto, with its many tiny alternating currents, was one of those good ideas we speak of. The sudden growth of electrical enterprise spread over the country with the rapidity of fire. For a short time more attention was paid to continuous than to alternating-current machinery, but very soon this tide of opinion changed, and the two great and strongly allied departments of electrical engineering grew with many ramifications and side growths. Jablochkoff years ago, with his twin-electric candles,did his best to make alternating-current arc lighting a success in Paris. In Buda Pesth heavy machinery soon came into existence. Alternators of a very large size began to be manufactured and accepted as a matter of course. The great field of alternating-current practice soon convinced the most skeptical that two lines of work ran parallel; that it was bigotry to deny this fact or affirm to the contrary. Thus it seems the consumer looked with gradual favor upon those whose efforts led them to achieve success in a newer, because a more retarded field of investigation. Many remarkable steps have been made in the furtherance of, not only generators of alternating currents, but transforming devices and motors. In the generator of power it was found advisable to depart somewhat from the monotony of precedent and to cut a new path to suit and meet the exigencies of practice.

The current could be more satisfactorily distributed by redesigning the alternator; it could be transformed with equal economy, and in addition provide a current whose nature made it unique and useful, so that its application to motors, appropriately designed, was immediate and practical. This then composed the points gained by the new departure. It needed but little to give a vast impetus to these new and fertile systems, to progress far beyond the hopes of the most sanguine. There is a certain sense of satisfaction to be felt in briefly reviewing the growth of this most necessary branch of engineering, and the antagonism displayed at times by those hostile to its advancement and fearful of its possible encroachment.



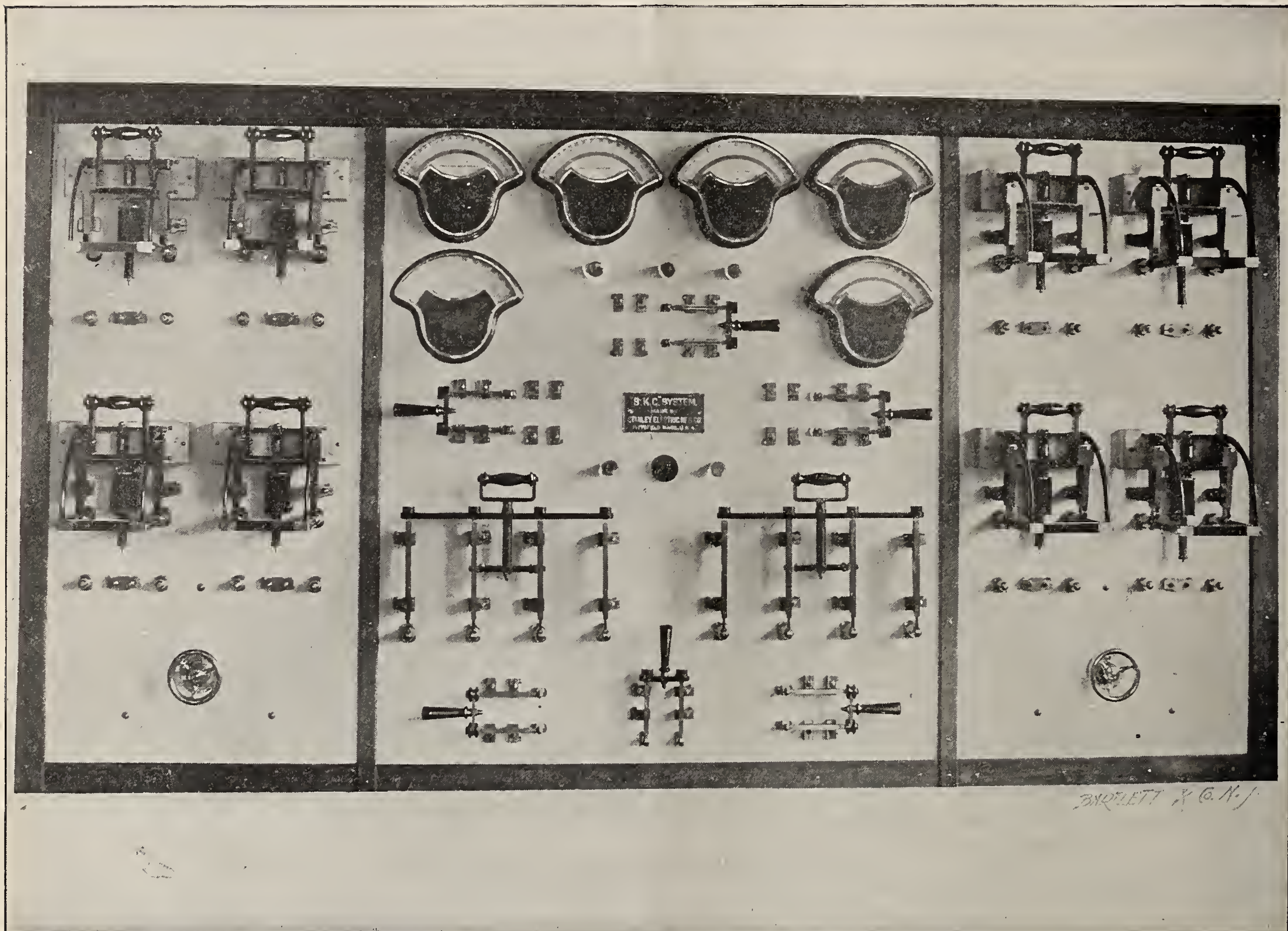
Fifty-Kilowatt S. K. C. Generator.

The inventor has worked to advantage in adding to electrical engineering so many valuable features. The single-phase, monocyclic, three-phase and two-phase constitute the results of his work.

Single-phase alternating-current systems are not of the most satisfactory nature for several reasons. No good single-phase motor has been able to retain its position and become as essential as its merits would seem to require. It is inherently deficient in many respects that have not been as yet overcome and the difficulty of providing appliances that do not detract from its excellence make it still a means, but not the means, of providing power on alternating-current circuits.

The monocyclic is not inferior to a single-phase system, but its demands are such that it savors of experiment more than good commercial engineering. We may keep in mind an important statement once made by an eminent

professor when asked what engineering was: Why, engineering is the art of making money. The cuts which illuminate these pages are representations of machines which testify to this principle. Not only is the manufacturer benefited by their sale, by the credit and reputation the machines bring, but the customer likewise. His experience with them is untouched by disapproval and partakes of a deep satisfaction created by their continued excellence. A 30-kilowatt S. K. C. generator is thus presented for the reader's inspection that he may judge as far as possible of its superior qualities. These machines generate either a two or three-phase current, the purpose of which will be furthermore explained after the reader is familiar with the appearance of a few more. A 75-kilowatt S. K. C. generator, a 600-kilowatt with its modified framework and bearings, a 30-HP. S. K. C. motor driving a pump, and a switchboard from which the circuits of a multi-phase system radiate, are reproduced for the purpose of illustrating the substance of our remarks.



Switchboard in Station of St. Louis Electric Light & Power Co.

The two-phase system, to complete this slight digression, is exceedingly useful, because it enables us to transmit power economically at high potentials over long distances, and because the light and power service on such lines is easily rendered.

A three-phase system is not so generally applicable. The three circuits are electrically interlinked on the generator armature, and therefore the electromotive force on any two of these circuits is oppositely affected by the amount of current flowing in the remaining one. The current must be the same in the three circuits when a three-phase motor is applied. Copper is saved in distributing light and power, but this is entirely swept aside by the fact that without an electrical balance a motor's use is impossible, and its extension, therefore is unfruitful and uncommercial. We have thus viewed briefly the effectual influence of these new and admirable systems of light and power by alternating currents.

FISHING BY ELECTRICITY.

The action of the electric current on fishes has suggested to "Cosmos" (Paris) a method of fishing by electricity, which it describes apparently for the purpose of calling attention to the facts on which it is founded, rather than with any serious intention of recommending it for practical use. We translate the article below:

"We described the other day the astonishing evolutions of tadpoles subjected to the action of an induction current. 'L'Etincelle Electrique' now gives us the means of utilizing the same effects in the case of fishes.

"In the glass prison of an aquarium swim peacefully several small fish. You approach, armed with two metal plates connected to the two poles of a small Ruhmkorff coil.

"You plunge the two plates in the aquarium, one on each side, at A and B. The innocent victims, suspecting nothing of your evil designs, manifest at first a little fear mingled with curiosity, but soon resume the peaceful course of their graceful evolutions.

"The zincs of your battery having been lowered so as just to touch the liquid, and the screw of your coil regulated so that its point is not in perfect contact with the vibrator, you draw the latter over against the coil and then let go. There result a few vibrations each followed by a contact, and consequently by the sending of a few

(Continued on Page 524.)

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CONTENTS.

	PAGE
EDITORIALS	
Electrolytic Action Near Trolley Roads	523
Testing Steel by Its Hysteresis	523
Effect of Current on an Organism	523
GENERAL SUBJECTS	
Light and Power by Alternating Currents	519
Model Plants	524
Standards of Light	526
Street Railway Association	530
MISCELLANEOUS	
Electrolysis Suit of Omaha Water Works Company	518
Fishing by Electricity	522
Ancient Lamps	529
TRADE NOTES	
A Winning Electric Carriage	517
Insulating Machines	527
Something New in the Art of Galvanizing	530
Possible Contracts	531
Telephone Notes	532
NEW CORPORATIONS	531
PATENTS	532

ELECTROLYTIC ACTION NEAR TROLLEY ROADS.

A case has been reported which is of the greatest interest to the builders and supporters of trolley roads. A suit for $250,000 damages to water pipes, entered by the Omaha Water-Works Company against the Omaha Street Railway Company, seems to show that considerable faith has been placed in the statement, made on many occasions, that water pipes in proximity to trolley roads are eventually ruined. It is difficult to pronounce a verdict in all cases. A series of conditions may exist which may rapidly destroy the pipe system of a company. Fortunately these conditions are rare. But a case in which not only a formal complaint is made, but a suit instituted for a quarter of a million dollars damages will, whether the same be imaginary or real, bring investigation instantly to a focus and demand the closest attention.

If electrolysis occurs to such an extent as to depreciate and seriously injure the property of a water-works either the trolley companies will be forced to adopt some preventative or the pipes of the water-works insulated or otherwise protected from such evil effects. With a great system of piping and an extensive road the evidences of such action would be strikingly apparent. There would be a series of interesting cases at once developed in all centres reached by the scare, and trolley companies and water-works would wage war to the knife. Is there any foundation for such a distressing situation? The passage of a current through a pipe would only occur if the road were poorly connected. In a well-bonded road such a phenomenon is impossible.

One block of the trolley road was not in a model condition. The neighboring pipes suffered and a suit instituted without further delay. It was discovered that the trouble was purely local. The pipes were intact. The water-works representatives at once asked for a dismissal of the case. We think it a compliment to the trolley road that the final scene was amicable to both. Had its road been poorly constructed, it is likely the pipes would have suffered and the trouble been severe and general in its character.

TESTING STEEL BY ITS HYSTERESIS.

The purification of steel for dynamo construction has given a better and lighter metal to the manufacturer. The magnetic qualities of steel and its mouldable properties make it especially desirable for this purpose. The high magnetic flux a given cross-section will carry and its superior permeability place it but an iota below the best wrought iron.

The presence of impurities in steel are quickly detectable. By rapidly magnetizing and demagnetizing it, its hysteretic properties cause it to absorb, in proportion to these impurities, considerable energy. It might be remembered that lamination is for the purpose of destroying Foucault currents; it cannot reduce hysteresis in the least. The quality of the steel would have an immediate effect upon the amount of energy transformed by hysteresis. With very soft iron and hard steel the ratio of power wasted is about 9 : 60; it may run as high as 9 : 117. By testing a good sample, a table could be drawn up giving values for others, to be used in the future as a reference.

EFFECT OF CURRENT ON AN ORGANISM.

Nerve energy is probably due to a species of molecular action originating in the brain. Our own power of volition creates these impulses, which extend to whatever part of the body our will directs them. Between the electric current and the life of a nerve a certain similarity exists. In cases of locomotar-ataxia the retarded passage of nervous energy is strikingly evident in the duplication of effects by a current such as could only be produced by an inward physiological cause.

In the stimulation of certain centres w ealso find the current an apt substitute. It is not strange, therefore, to hear a French scientist declare that the passage of a strong current through the germ of an egg will so affect it as to produce a strange and monstrous growth when hatched.

What frightfully abortive types can be developed through the agency of a current future experiments will soon show.

Glass that Transmits Light but not Heat.—In regard to the recently announced production in Germany of glass capable of transmitting light freely, but not heat, the "American Journal of Photography" states that a plate of such material, four-tenths of an inch thick, containing 28% of iron in the form of ferrous chloride, allowed only the small amount of 4.06% of radial heat to pass through it, while another plate of equal thickness, and containing quite as much iron in the form of ferric chloride, permitted an amount equal to 11.2% to pass. The chemical distinction is said to be very small, but the effect quite marked. A thinner slab of the glass in question is reported as allowing less than 1% of the heat of gas flames to pass, although transmitting 12% of heat from sunlight; ordinary window glass lets some 86% of the heat through.

What Coal Loses.—Investigation has lately demonstrated that coal may lose as much as 33.08% in weight from exposure to the weather, while the loss is made even more considerable by the deterioration in quality.—Industrial World.

The Infinity of Space.—The light of stars reaches us from space depths so profound that it requires thousands of years, traveling at the high rate of 186,000 miles a second, to reach the earth, and every increase of aperture of our telescopes shows the existence of others still more remote.

brief induction currents through the liquid of the aquarium. The fish seem struck with madness. With an expression which if you are a physiognomist you will certainly find to be that of astonishment, they execute a frenzied saraband in their prison.

"But this is only a foretaste of what awaits the poor creatures, victims of your passion for electrophysiology.

"Immerse your zincs entirely and screw up the vibrator screw so that the coil will work normally. Then there is no more anger among the poor fish, but resignation; as soon as they pass between the two fatal plates, they rise to the surface, bellies upward. The effect is very striking, and curious to observe.

"Nevertheless, it is only the appearance of death, perhaps only a trick; if you have not used a very powerful battery, whenever the current ceases, whenever you stop the vibrating hammer with your finger, the fishes turn over, and as soon as you let the vibrator go, they turn belly upward again and rise once more to the surface. Let us hope that you have some humanity and that after a few experiments of this kind you will put them back in the brook where they were born.

"What an ideal manner of fishing, if generalized a little! We should only have to immerse, between the two banks of a stream, two plates connected with an alternating current machine of sufficient strength, and at each throb of the current we should see rising to the surface all the fish that were passing between the two plates. We should only have to take our pick and collect those that we should choose.

"There would be only one obstacles—the fishery laws!" —Translated for "The Literary Digest."

Nature's Abhorrence.—A French experimenter, Camille Dareste, has found that the germ in the hen's egg is not destroyed by an electric current that would kill an adult fowl, but that the germ is so modified in most cases that a monstrosity will be hatched.—The World's Progress.

Hamilton, Ont.—The Radial Railway Company will extend its line from the power house to Port Nelson, and next spring it will be extended to Oakville.

Belleville, Ont.—Messrs: Pinkerton & Cook, of Toronto, are negotiating for the purchase of the street railway franchise here.

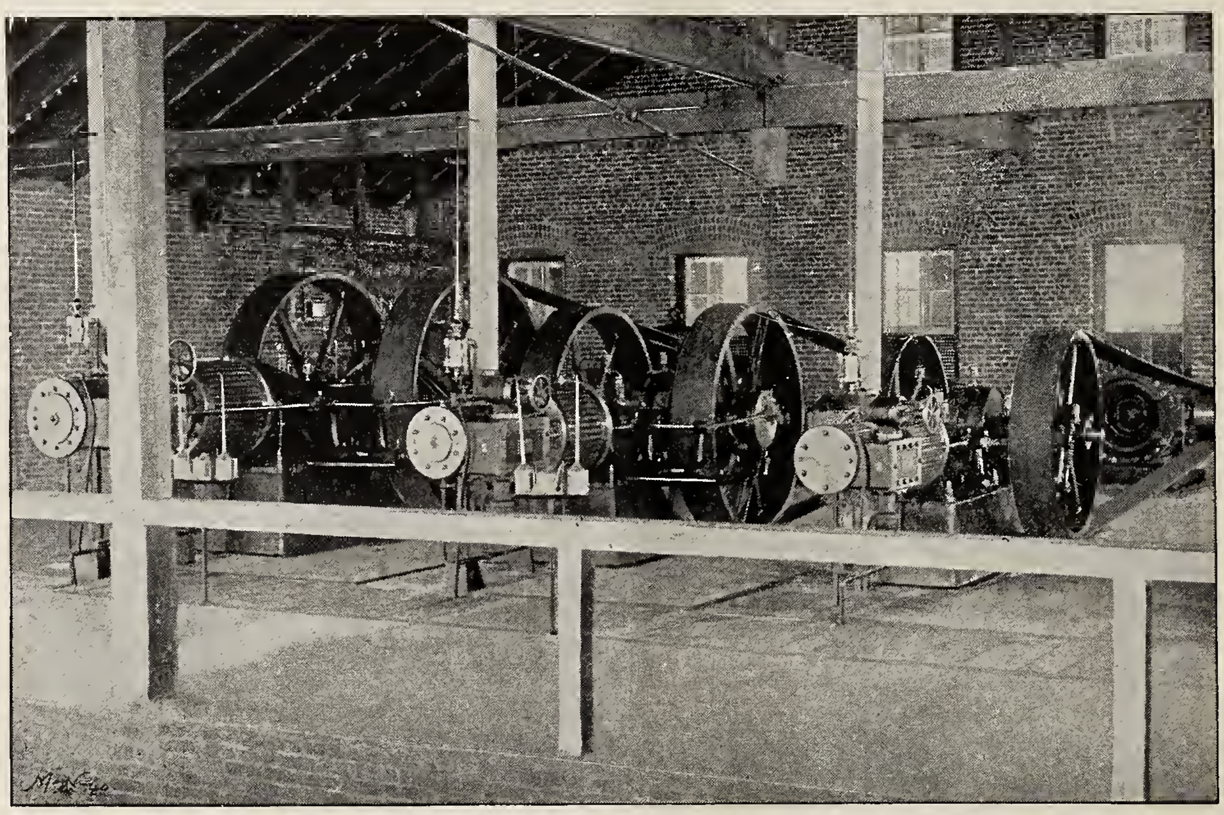
MODEL PLANTS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The expression "model plant" is self-explanatory. To the engineer, a perfectly equipped system of electric light appeals as strongly to his sense of beauty and idea of completeness as a work of art, of sculpture or of rare design. A harmony can exist in the engine room or station that suggests at once the touch of a skilled hand and comprehensive view of an experienced mind.

To construct a model plant is not only to set up an engine and dynamo on a substantial foundation, but to have in addition to these the latest and best accessories for its smooth running, its ready supervision and economical handling. A model plant should never be wasteful, as the very object of having an elaborate outfit is to prevent or reduce the expense of operation. A model



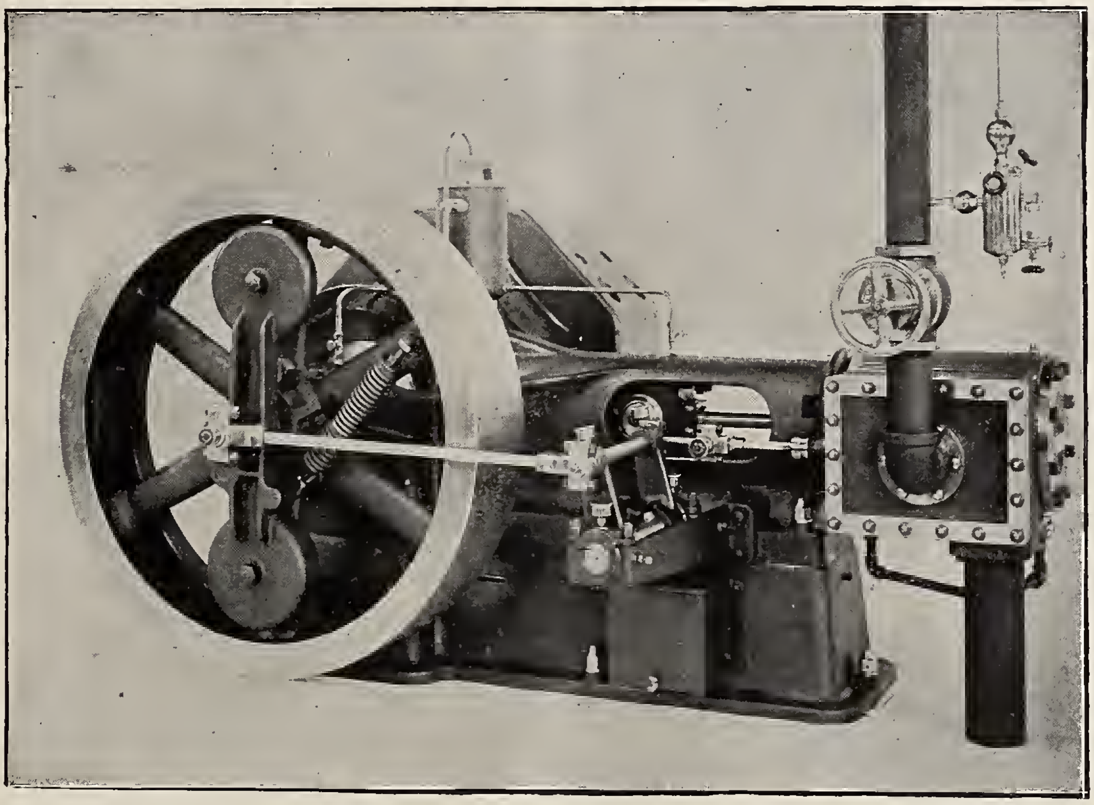
A Model Engine Plant.

plant should not be a source of constant bother; it should not necessarily include self-acting devices, which are too impractical and, therefore, unreliable for continued use. It has been discovered, in the majority of cases, that the beauty of a plant begins at the boilers and extends from there to the engine room. The essential parts of a model plant are—

An efficient boiler,
An automatic engine,
A self-regulating dynamo.

An efficient boiler can only be considered as such when its power of making steam is great in comparison with the weight of coal consumed. In all boilers a considerable quantity of unburned fuel escapes as smoke. Heat is wasted from the furnace, boiler shell, steam pipes, etc.; the very smoke that escapes is due to lost heat. An efficient boiler, as ordinarily understood, would be one a little better than the others. But supposing this slight gain in efficiency adds a great item of expense to the price of the boiler or necessitates such extra labor that the additional efficiency becomes a plague and a nuisance. There is evidently no gain in using a boiler of this kind. Here is a statement which will give an idea of the amount of power wasted between the furnace and the engine: "It

has been satisfactorily demonstrated that in the very best engine, even if it were theoretically perfect, and working at ordinary ranges of temperature, only somewhere about one-fourth of the heat which is actually employed is converted into work.; that is to say. three-fourths of the coals, or three-fourths of the heat employed, are absolutely wasted under the most favorable circumstances." Boilers are on the market today which are far superior to any previously introduced, which may use culm, the cheapest product of the mine, and in cheapness and serviceability highly commendable. The weight of coal consumed for a given quantity of steam can be otherwise put as the weight of coal consumed for a given amount of energy—so many pounds per horse-power hour.



Direct-Connected Model Electric Light Plant.

About two and a half to three pounds per H.-P. hour is the best point reached in practice with triple-expansion engines. The weight of coal may increase as high as five or six pounds per H.-P. hour in poor engine equipments.

An automatic engine is one which can regulate with changes of load; that is to say, keep its speed constant. This is very necessary with a dynamo attached, as a reduction of speed with an increase, or a raising of speed with a decrease of load would mean either a poor light from the lamps or an exceedingly bright light from them. The poor light fading with each new circuit thrown in, the bright light becoming dangerously stronger, to the detriment of its filament with a higher speed, due to the lesser load. A model plant must therefore have an engine of uniform speed, and as unchangeably so as possible. It must have an efficient boiler, which is clean and provided with the proper attachments for its protection, and the necessary heating surface, so as to burn its coal economically and well.

A self-regulating dynamo can only be called by that name if it fulfils the functions expected of it—if it sustains one pressure throughout all changes in the lights; if it is automatic; in other words, if it regulates. The best machines of today are of the multipolar type. They are not model machines, and cannot be considered a desirable addition to a model plant unless they regulate; do not heat, either in field, armature, bearings or commutator, and do not spark at the brushes. A dynamo from a mechanical standpoint is a simple piece of mechanism. It is not difficult to attain comparative perfection in this respect, and such perfection is essential. The electrical designer must provide the proper surfaces and cross sections for the radiation of heat. The current squared multiplied by the resistance in fields and armature respectively give the value of this in watts. The good design of a dynamo greatly depends upon the ability of its armature to radiate heat. Sparklessness is a feature which above all things should be absent.

A model plant can but begin to be such when a boiler, engine and dynamo meet these purely practical demands herein outlined. A switchboard containing voltmeters and ammeters, automatic cut-outs and ground detectors; a system of switches which places every circuit of consequence under the engineer's control, completes so necessary an adjunct to a complete plant. It becomes a model plant when the room is lofty and well lighted; when the engine and dynamo are upon solid foundations; when vibration is entirely absent and only the low murmur due to the perfection of such mechanism reaches the experienced ear.

Electro-Mechanical Water Wheel Governor.—The wide introduction of electric machinery driven by turbines has necessitated some modification of existing methods of varying the water-gate opening corresponding to changes in load. With ordinary mill work a regulation within 10% was admissible, but with electrical machinery it is necessary to regulate within 1%. The best way of doing this has been found to be in an electro-mechanical contrivance, consisting of an ordinary ball centrifugal governor, which, instead of acting directly, acts to regulate an electrical current, which operates the gate opening. This governor can be arranged so as fully to open or close a water gate in from 3 to 15 seconds, according to the requirements of the situation.

The Belknap Motor Co., Portland, are rushed with business. General Manager Brown reports orders in hand sufficient to keep the men busy for the next sixty days. At the West End Hotel, Portland, they are putting in an electric light plant, comprising one 500-light direct-coupled dynamo with an Ideal engine, the same as the one installed on the steamships Bay State and Portland. The contract includes an electric elevator to be supplied with power by the same dynamo. The Belknap Company are putting in at the West End Hotel probably the first return call annunciator ever installed in the State of Maine. The Belknap Co. are shipping motors to New York, Philadelphia and Boston, and notwithstanding the dull times business is rushing at the Belknap Co.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 508.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

THE GERMAN STANDARD CANDLE (VEREINSKERZE).

The specifications for the manufacture of this candle, adopted upon the recommendation of a committee of the German Association of Gas Manufacturers, are very careful and complete. The candle is made only under the immediate supervision of the association and is sold by them. The directions for its use are most minute. The photometric measurements are to be made only when the flame has reached its normal height of 50 mm., the rate of consumption of paraffine being disregarded. The candle is made of the purest paraffine, has a uniform diameter of 22 mm., the number of strands of wick, also, being carefully specified. In the earliest recommendations for the use of this candle it was directed that the candle be allowed to burn freely, and when the flame height had reached 50 mm., then the photometric settings were to be made. In later years, however, the recommendation was made that the wick of the candle be cleaned or snuffed in order to insure the reaching of the standard flame height more quickly. The use of this candle as an official standard has been abandoned even in Germany in favor of the Hefner lamp, and, consequently, it is not necessary to deal very extensively with tests which have been made of it.

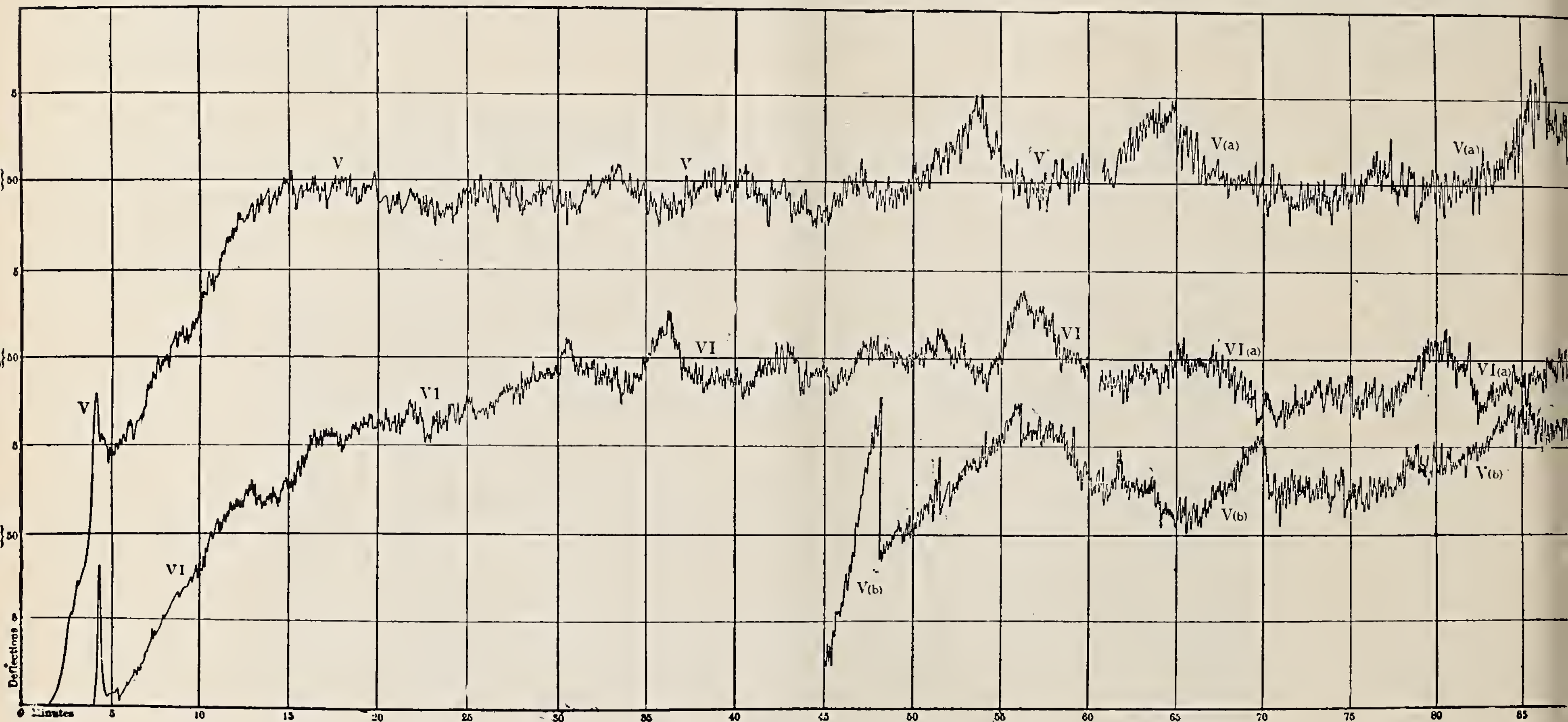


Fig. 10.—The German Candle.

Lummer and Brodhun[1] in determining the intensity of the Hefner light in terms of the German candle, using glow lamps as intermediate standards, investigated the performance of the candle with a good deal of care. Measuring the height of the flame by means of a cathotometer, they experienced difficulty in seeing the exact point of termination of the base of the flame, and also from the fact that the top would split up into three points, and when the height was near the normal height, the flame would smoke. Their measurements show that the ratio between flame height and intensity with this candle is not a fixed one.

At one time the height remained at 50 mm. for some minutes, and the following settings were made: 0.412, 0.420, 0.420, 0.424, 0.430. During this time the edges of the crater melted off to some degree.

Bolometer tests[2] of this standard were made by members of the present committee. They do not, however, show its behavior when used under normal conditions. They indicate a more uniform performance, except for continual small variations than is seen in the case of the British candle, and show clearly the greater care which is used to secure uniformity of wick, etc.

The data from which the curves in Fig. 10 are obtained are analogous to those presented in Tables I. and II. It will not be necessary to give them here. The following general statements concerning the results embodied in Fig. 10 may, however, be deemed of interest.

Curves V. and V.(*a*) and VI. and VI.(*a*) were obtained from candles burned in exactly the same way as III. and III.(*a*) and IV. and IV.(*a*), the time interval between V. and V.(*a*) being one hour, and that between VI. and VI.(*a*) being 41 minutes. Curve V.(*b*) was taken with the remainder of the candle used for V., relighted on another night; so that it is entirely independent of V. and V.(*a*) excepting that the same candle was used.

When we come to compare the English with the German candle, we notice, first, that the variations of the English candle were much larger and that large variations were much more frequent. The German curves are free from the semi-periodic drops which characterize the English. Curve I. at 24 minutes reaches a value which is 1.255 of the mean ordinate of the English candle curves. Curve IV. at 49 minutes drops to a point which is only 0.77 of the mean ordinate. The total variation is, consequently, 46.5%. Both of these curves were taken with the same candle, but on different nights. The highest point of the German curves is on V.(*a*) at 86 minutes. The ordinate reaches a value which is 1.155 of the mean. The lowest point is on VI.(*a*) at 72 minutes, and is 0.915 of the mean. The total variation was consequently 24%, or only about half that shown by the English candle.

Moreover, we see from the table that the percentage deviation of curve III., 55-60 minutes, from the mean of the English candle is plus 10.45%. Curve IV., 35-40

1.—Lummer and Brodhun: *Zeitschr. fur Instrumentenkunde*, vol. 10, p. 119.

2.—Sharp and Trumbull, *Phys. Rev.*, vol. ii, p. 1.

minutes, shows a deviation of minus 13.08%. The total deviation for a period of five minutes is 23.53% for the English candles. In the German candles the maximum positive and negative deviations for five-minute periods are plus 11.52% and minus 10.43%, respectively. These give a total of 21.95% and exhibit a performance but little better than that shown by the English candle.

(To be continued.)

INSULATING MACHINES.

Of the several types of insulating coverings for wires and cables, it has been found that the strongest and most effective is a continuous, seamless covering of India-rubber or gutta-percha; preferably the latter. These materials are not only non-conductors, offering high resistance to the passage of the electric current, but are also of such a nature that it is possible to apply them to wire without mechanical support from any other substance. As they are also practically impermeable to water, and as gutta-percha, in particular, does not readily yield to the chemical action of acids and alkalies, they have been practically exclusively adopted for submarine and underground conductors, and for use in all places where the strain on the insulating cover is unusually severe.

For submarine work, especially where the conditions surrounding the cable are very trying, and where the slightest leak is severely felt, experience has shown that only those conductors are thoroughly reliable in which the covering is seamless; that is, where the insulating envelope is laid on in the form of an unbroken cylinder, closely surrounding the wire and cohering equally at all points. For doing this work very ingeniously constructed machines are built, a short description of which may not be uninteresting.

While differing somewhat in detail, the central idea of all machines for covering wire with seamless insulation is that of a cylinder in which the gum can be rendered plastic, to a greater or less degree, through the action of heat; an arrangement of screw or piston for forging it through a more or less contracted outlet; and such an arrangement of the adjacent parts as will permit of the uncovered conductor being passed through this outlet, at the same time as the gum, the gum being deposited on the surface of the wire as they pass through the machine together.

The accompanying illustration (Fig. 1) shows a machine in which the wire passes through the machine at right angles to the motion of the stock-worm. The machine shown is one of the smaller sizes of those offered, and is only used for wires and cables of a diameter not exceeding one-half inch. The small pieces shown in the foreground are the dies, guiders, etc., used for handling different sizes of wire, these parts of the machine being interchangeable, so that any size of wire can be handled up to the limit of the capacity of the machine.

The above diagram (Fig. 2) shows the plan of a side delivery insulating machine, and will give a clear idea of its operation.

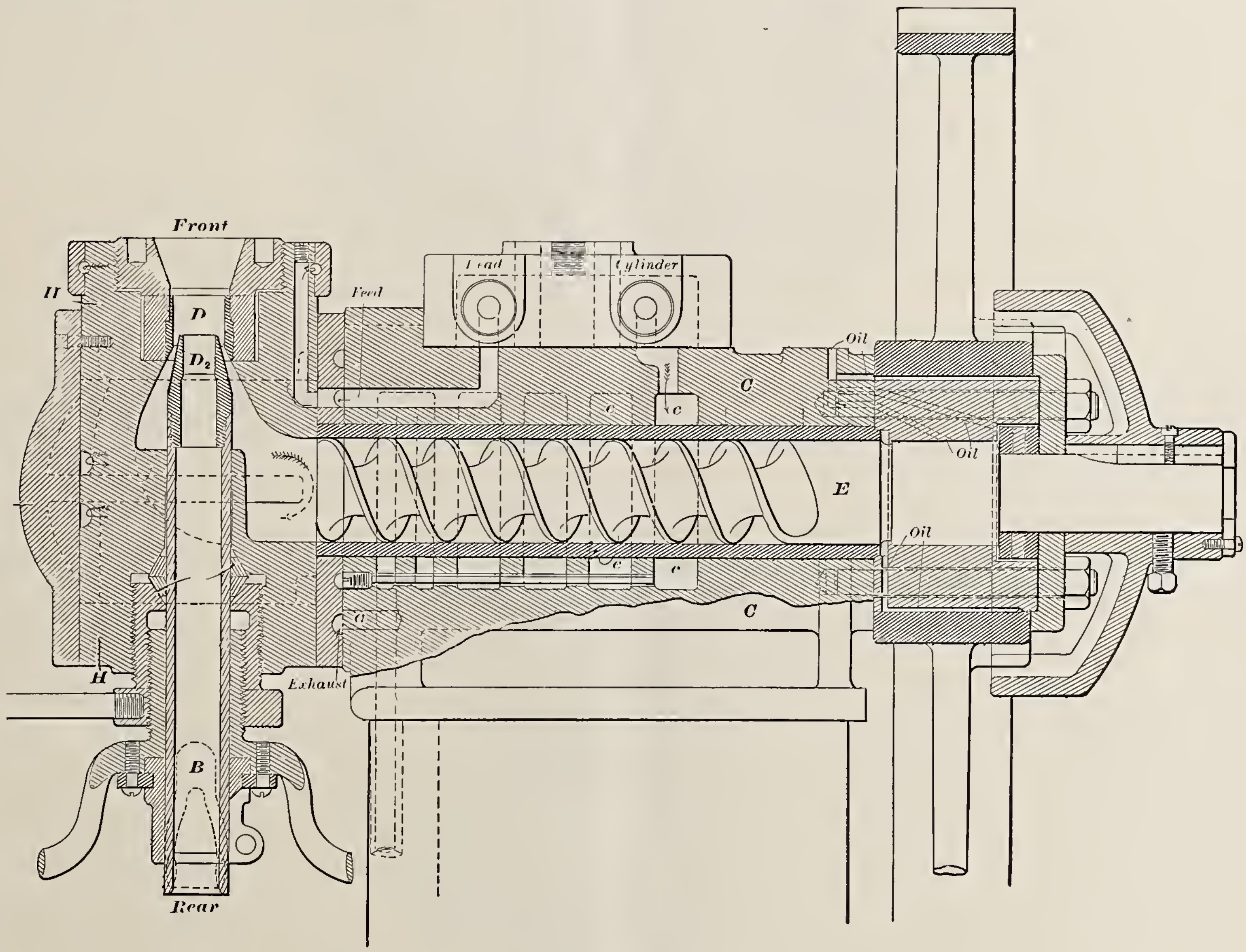


Fig. 2.

The cylinder, C, is of cast-iron, and has internal circumferential passages "e" connecting with a steamchest, by means of which a proper degree of heat may be established and maintained. The gum, cut into strips of proper dimensions, is fed to the stock-screw "E" through an aperture in the cylinder, and is carried forward to the head section "H" by the screw and forced through the die, "D," passing out of the machine in a continuous stream. The wire is entered at the rear of the head section, "H," travels through the tube, "B," and finally through a guider "D2," this guider being varied in size to match the wire being handled, fitting it snugly and serving to centralize it with reference to the insulation.

From the above brief description the operation of an insulating machine, in its more salient features, will be readily understood. In effect, the wire and compound are forced through the machine at one and the same time, the direction of their respective courses being at right angles to each other, at the commencement of their course; but, through the alteration of the direction of the

flow of the conpound in the head, both are delivered simultaneously, and in the form of a completedly insulated wire.

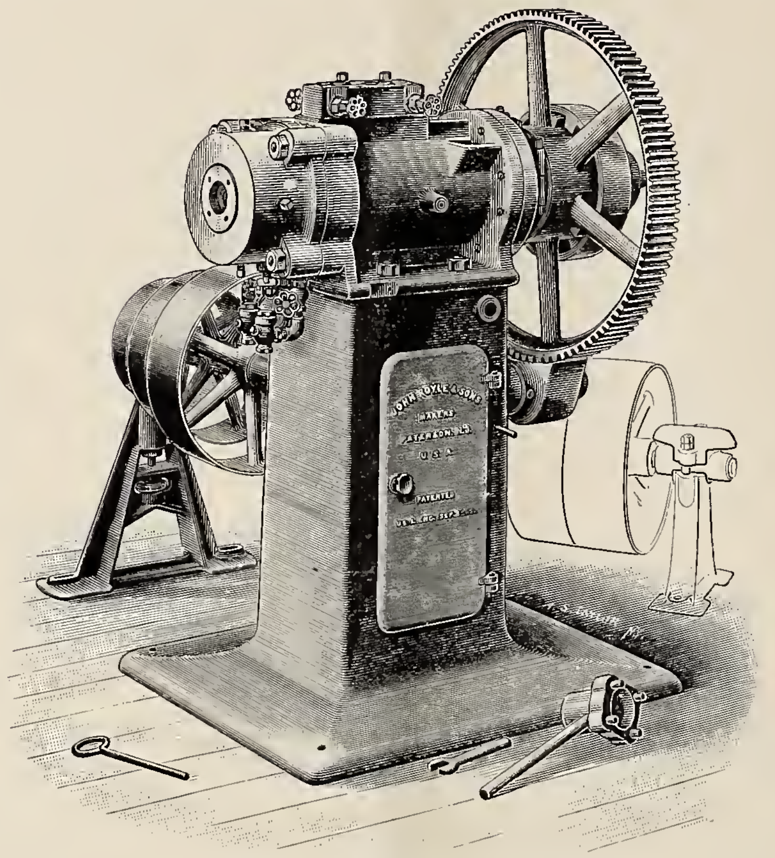


Fig. 3.

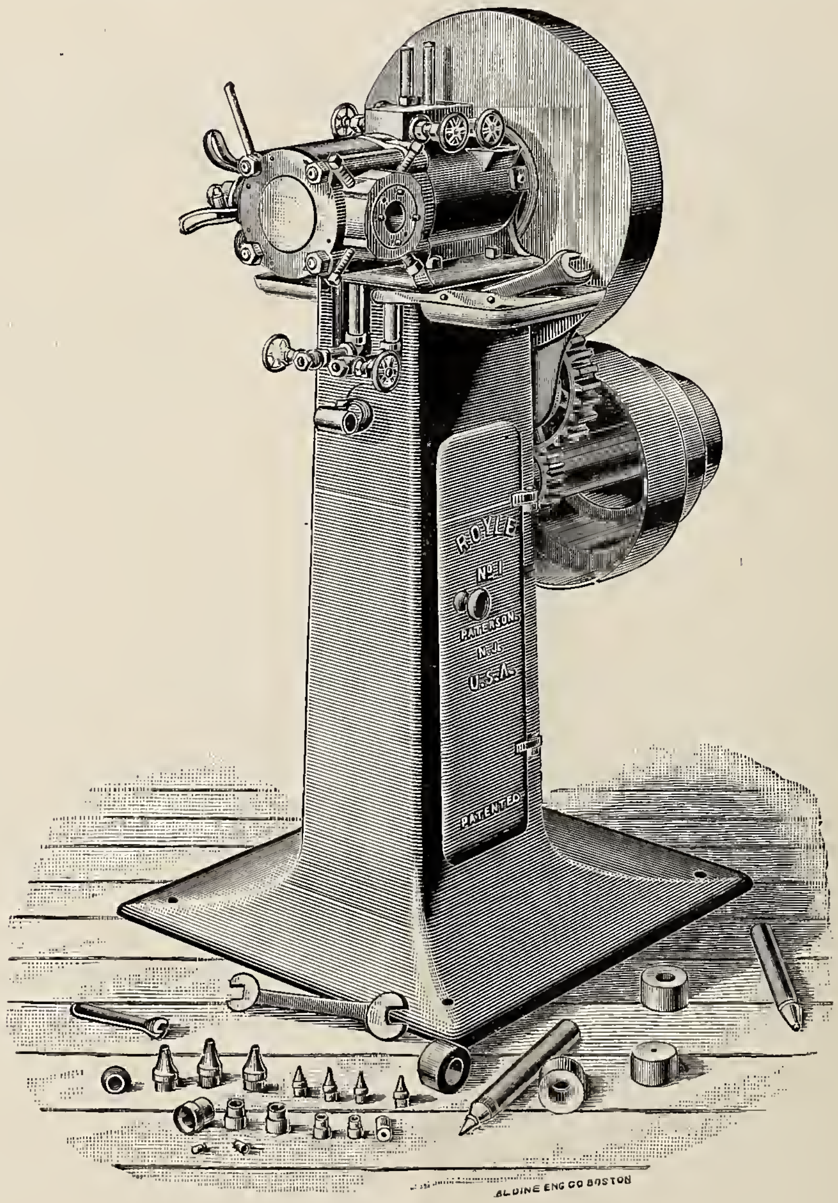
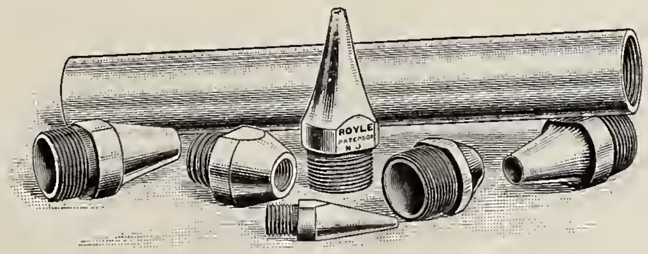


Fig. 1.

The insulating envelope laid on by machines of this type is the most perfect known, there being no seams or other weak points in it. To obtain uniform results, however, some practical experience is necessary. In the first place, in order to flow easily and form a homogeneous cover on the wire, it is necessary to render the gum in the cylinder plastic by the application of heat, the degree to be applied varying greatly according to the nature of the compound in use. This is a very important factor in the manufacture of insulated wire, and the proper temperature should be carefully determined by experiment. If the cylinder be too cold, the delivery is apt to be uneven, whereas if too great a degree of heat be applied, partial vulcanization may ensue. In all properly constructed insulating machines, great attention is paid to the supplying

of the necessary means for regulating the temperature, a suitable steamchest being attached for governing the introduction of both steam and cold water into the passages surrounding the cylinder, so that, by mingling the two, the temperature may be regulated with great exactness.

For regulating the thickness of the insulating compound deposited on the wires, movable dies are used, the arrangement of the head section being such as to permit of these fixtures being readily changed. Theoretically, the diameter of the die used should exceed the diameter of the wire by the thickness of the wall of insulation. In practice, however, it is found that the thickness of this wall is materially affected by the nature of the compound and the conditions under which it is worked. Some compounds possess great inherent elasticity, and have a strong tendency to expand when released from the pressure of the die. All compounds tend to vary in bulk, as they are cooled off after leaving the cylinder, so that it is apparent that, in order to produce mathematically accurate results, the action of each particular compound



should be carefully determined by practice and the dimensions of the die regulated accordingly.

While machines in which the initial movements of the wire and compound are at right angles to each other possess certain advantages, there is necessarily considerable friction and loss of speed in altering the course of the compound, and to do away with this and get the maximum results from the power applied, machines are now built in which the wire to be insulated passes through the stock-screw, which is hollow, and is delivered at the front of the machine instead of at the side; the wire and compound thus moving in a direct line, without either being deflected at any point of their course. The general construction of these machines closely resembles that of the side-delivery type already described, the compound being fed to the cylinder and heated in much the same manner and the dies and guiders being also similar in form. There is a great difference, however, in matters of detail, and the workmanship in the straight-delivery machines is generally of a very high order.

There is a radical difference in the working capacity of the two types, the side-delivery type delivering less product, but accommodating wires of greater diameter; while in the straight-delivery machines, the output is much greater, but the diameter of wire that the machine will accommodate is limited.

Side-delivery machines are those commonly used at the present time, but the recent introduction of a straight-delivery machine of greatly improved form will doubtless lead to the adoption of machines of this type for doing a large proportion of the work now done on side-delivery machines, the larger quantity of work turned out in a given time very materially reducing the cost of production. Fig. 3 shows a straight-delivery machine of the latest type.

In the foregoing description, the standard machines built by John Royle & Sons, Paterson, N. J., have been taken as models, these machines best illustrating the distinctive features of the different types. V. B.

ANCIENT LAMPS.

The invention of lamps is ascribed to the Egyptians. In the British Museum are two colored glazed tiles which were fixed in the centre of the ceiling; each has a large knob pierced through the base to receive a cord for suspending a lamp; around the base of each is an inscription stating that it formed part of the decoration of the Temple of Kammuri at Calah Nimrod in the time of Assuru-Abla, 885 B. C. What the lamps were made of cannot now be ascertained, but there is plenty of contemporaneous glass which has been discovered in the neighborhood.

The sacred lamps in Greek temples whose undying flames were perpetually watched by vestas were probably of metal, and the wick formed of asbestos.

In the public baths at Pompeii two lamps were used, each to light two rooms. These lamps were protected by circular convex glasses, fragments of which were found on the spot.

The marvellous accounts by mediaeval authors of perpetually burning lamps found in ancient tombs seem too numerous and too well tested to be altogether fabulous. When the tomb of Pallas, son of Evander, who is mentioned by Virgil, was discovered about the twelfth century by a countryman digging near Rome, it is said a lighted lamp was still burning over his head, which must have been lighted more than 2,000 years, and might be called "eternal."

Baptista Porta, in his treatise on natural magic, relates that about 1550 a marble sepulchre of the Roman period was discovered in an island near Naples, and on opening the tomb was found a phial containing a burning lamp. This light became extinct on breaking the phial and exposing the flame to the open air. It was supposed that this lamp had been concealed before the Christian era, and those who saw it reported that the lamp emitted a splendid flame.

In 1550 a remarkable lamp was found near Atestes, Padua, by a rustic digging, who unearthed a terra cotta urn containing another urn, in which was a lamp placed between two cylindrical vessels, one of gold and the other silver, each of which was full of a very pure liquid, by whose virtue the lamp had been kept shining upward of 1500 years. This curious lamp was not meant to scare away evil spirits from a tomb, but was an attempt to perpetuate the profound knowledge of Maximus Olybius, who effected this wonder by his extraordinary skill in chemical art.

St. Augustine says a lamp was found in the Temple of Venus, exposed always to the open weather, and which could never be extinguished. Ludovicus Fives mentions another lamp, which was found a little before his time, that had continued burning for 1050 years.

Licetus is of the opinion that the perpetuity of these lamps was owing to the consummate tenacity of the unctuous matter with which the flame was united being so proportioned to the strength of the fire that, like the radical heat and natural moisture in animals, neither of them could conquer, or destroy, the other. In order to preserve this equality of proportion these lamps were hid in caverns or closed monuments. On opening these tombs, the admission of fresh air has produced so great an inequality between the flame and the oil that they have become extinguished. In Henry VIII.'s time a lamp was found in a monastic tomb that had been burning for 1200 years.—The World of Progress.

The American Street Railway Association will hold a meeting in the big Republican Convention building of St. Louis, Mo., Oct. 20, 21 and 22. This will, we expect, be a representative gathering and be the means of bringing together some of our kings of the trolley.

STREET RAILWAY ASSOCIATION.

The following is a schedule of proceedings of the Street Railway Association of the State of New York. The general details of the meeting, with a few views of the city of Binghamton, was published in previous issues. It will be our pleasure to outline more thoroughly the work done at the meeting and review or possibly publish some of the papers read which might interest our readers.

Programme of the fourteenth annual meeting of the Street Railway Association of the State of New York, to

G. T. Rogers, re-elected President New York State Street Railway Association.

be held at Hotel Bennett, Binghamton, N. Y., Tuesday, Sept. 8th, 1896.

9:30 a. m., meeting of the Executive Committee. 10:30 a. m., meeting of the Association.

Order of Business.—1. Call of the roll. 2. Approval of the minutes. 3. Address of the president. 4. Report of the Executive Committee. 5. Minutes of special meeting of the Executive Committee. 6. Report of the treasurer. 7. Reading of papers on practical street railroad questions, by well-known gentlemen. Names and subjects to be announced. 8. Discussion ensuing. 9. General business—I. Appointing of nominating committee; (a) Nominations of officers, (b) Selection of place of next meeting; II. Election of officers. 10. Adjournment. 11. General entertainment, including trolley ride to Ross Park, State Hospital and other local points of interest, terminating with a ten-mile ride to Union. (Luncheon served at the Casino.) 12. 8:30 Banquet at Hotel Bennett.

Officers.—President, G. Tracy Rogers, Binghamton, N. Y.; Vice-Presidents, W. W. Cole, Elmira, N.Y.; John H. Moffitt, Syracuse, N. Y.; Secretary and Treasurer, Benj. Frick, Brooklyn, N. Y.; Executive Committee, G. Tracy Rogers, H. W. Watson, H. H. Vreeland, John W. McNamara, Benj. Frick.

SOMETHING NEW IN THE ART OF GALVANIZING—GALVANIZING BY A COLD WAY.

A new departure has been made from an old and well trodden path. For many years iron has been galvanized by dipping it into molten zinc. The waste of material, heat and other objectionable qualities were endured but not forgotten. The change that has been instituted makes a saving on all sides. It is in striking contrast with the old method and bears the stamp of progressive enterprise. The U. S. Electro-Galvanizing Co., of No. 186 Cook street, Brooklyn, is the originator of this process. Mr. Louis Potthoff, the general manager of the company, is the inventor. After a long series of experiments satisfactory results were obtained; the present officers organized under the above name, securing at the same time the patent rights for galvanizing carried on by this method.

Some of the reasons why this new process is superior to the old method are the following:

It saves 90% of spelter; saves fuel; saves the intense heat to the operators, that is unavoidable in the old method; saves all sal ammoniac (none used); saves expenses of iron galvanizing pots; absolutely no dross. An absolutely smooth surface is preserved. For coating springs of all kinds this process is invaluable, as the temper is in no wise destroyed. Bolts, nuts and screws of all kinds can be coated without having to clean the threads before using. Hinges, hooks, nails and rivets treated this way are smooth, clean and free from sharp, ragged edges. Another great advantage of this system lies in the fact, that articles coated by this electrical process can be plated with gold, silver, nickel, bronze, etc.

The Iron-Clad Manufacturing Company is largely interested in the matter and has at its works, No. 186 Cook street, Brooklyn, N. Y., the process of electro-galvanizing in operation.

Manufacturers can now do their own galvanizing, as small or large plants can be readily erected. The company can show credentials from abroad which are in strict accordance with the above facts, and show clearly the great superiority of this process to all others. Their patents exist in the leading countries of the world and letters from these parts testify to the extreme excellence and value of this new system.

NOTICE.

The business of Abraham L. Bogart, deceased, including his stock, patents, lease and good will, will be conducted under the well-known name of A. L. Bogart. The undersigned, having purchased the same, would solicit a continuance of orders for electrical specialties manufactured by the late Mr. Bogart.

The practical and mechanical departments will continue under the superintendence of Mr. A. Livingston Bogart.

Eugene E. Bogart,
No. 22 Union square, New York City.

L. Copleston, agent of the Watertown Steam Engine Company, of No. 39 Cortlandt street, New York, has secured the order for three vertical automatic compound direct-connected engines for the Pope Manufacturing Company, of Hartford, Conn. They will be used for the lighting and power of their new building. A pair of horizontal, automatic direct-connected engines of 175 horse-power each for lighting the Windsor Hotel, at 46th street and 5th avenue, have been likewise installed. A 130 horse-power horizontal automatic direct-connected engine for the Roosevelt Hospital, New York, was sold by the above concern, and a number of others were sold in New York and its vicinity during the past month. The engine this company exhibited at the exposition was set up in the Maggie Mitchell apartment house, New York.

The American Stoker Company has recently furnished the following stoker equipments: Pennsylvania R. R. Co., shops, Columbus, O., second order; Davis & Egan Machine Tool Co., Cincinnati, O.; Toledo Brewing & Malting Co., Toledo, O.; Michigan Carbon Works, Detroit, Mich., second order; John C. Roth Packing Co., Cincinnati, O.; Cleveland City Water-Works, Cleveland, Ohio.

The Kensington Electric Co., 2514 Frankford avenue,
Philadelphia, May 25, 1896.

Autimatic Circuit Breaker Co., Newaygo, Mich.

Gentlemen:—Your favor of 22d received at a very opportune time. We have just experienced a short circuit on our underground line and the breaker worked admirably—the result is, I am enabled to send you an order for twelve No. 28 circuit breakers, which I will have mounted as you suggest; two on one piece of marble 20x 17, and thank you for the suggestion.

I will return the one I now have as soon as I receive the others, which you will make as soon as possible.

Very truly yours, E. T. Wilkinson, Sec.

Mr. H. Krantz, Nos. 626, 628 and 630 4th avenue, Brooklyn, N. Y., the manufacturer of switchboards and switchboard specialites, is a practical electrical and mechanical engineer and expert. He is making a fine line of switches, either plain or quick-break, of any carrying capacity. The works occupy the main floors of three buildings. The building, corner 4th avenue and 18th street, is fitted out with all the latest improved lathes, planes, screw-cutting machines, large rotary drills, etc., the other floors being used for fitting up switchboards in fine marble or slate. He carries a large stock of marble and slate, and all kinds of metal for the rapid completion of switchboards for hurry orders. The office and draughting room is in No. 626 4th avenue. He is building a large number of switchboards for the leading electrical contractors of New York, and lately installed two large switchboards of over 4,400 amperes capacity in the Havemeyer Stores, Prince street and Broadway. A handsome white marble board of Mr. Krantz's make of 3,500 amperes capacity was installed by the Brooklyn Electric Equipment Company, in Lord's court, William street and Exchange place, New York. Mr. Krantz is manufacturing a large line of special electrical apparatus for the trade and is prepared to undertake the manufacturing for stock orders all kinds of electrical and mechanical apparatus of any nature. Mr. Krantz has just received an order for a 17 x 7 feet high white marble switchboard, said to be the largest and finest in New York City.

Iron-clad rheostats can't be touched by any other; theatre dimmers of all descriptions, motor and dynamo rheostats, X-ray rheostats, cautery rheostats, storage battery rheostats, are being hustled out as lively as possible by the Iron-Clad Rheostat Company, Westfield, N. J., U. S. A.

POSSIBLE CONTRACTS.

Philadelphia, Pa.—Wilson Bros. & Co., architects, are figuring on plans for a college building to be erected at 19th and Hamilton streets, for the Philadelphia Dental College. It is to be of iron, brick and stone, four stories high, steam heat, the fan system of ventilation, electric lighting and power which can be used in any room for the manufacture of teeth. The total cost of the college is not to exceed $100,000.——It is probable that the tall tower of the city hall will be illuminated with electricity next year. Commissioner Harris had a resolution adopted by the Public Buildings Commission requiring the Superintendent of Public Lighting to furnish plans and an estimate of the cost.

Portland, Ore.—Arlington, Ore., is contemplating the construction of an electric light plant.

Washington, D. C.—Treasury Department.—Sealed proposals will be received at this department until 2 o'clock p. m., Wednesday, Sept. 16, 1896, for the purchase of a hydraulic elevator plant, which can be used for passenger or freight purposes. C. S. Hamlin, Acting Secretary.

Anderson.—The National Tin Plate Company of this city decided to erect another plant, but place this one in the East—in Pennsylvania. It will be a nine-mill concern, and they advertise for bids of bonus for the location of the plant.

Three Rivers, Que.—The city has sold its electric light plant to Messrs. Fregean and Lacroix. The new company will get their power from the Bastiscan River, from falls at Price's Mills. The current will, therefore, have to be transmitted fourteen miles to the city. It is also proposed to supply neighboring villages.

Newmarket, Ont.—The by-laws to install an electric plant has been carried. Debentures for $10,000 will be issued.

Buckingham, Que.—Messrs. Ross Bros. will place an electric light plant in their new sawmill.

Quebec, Que.—The engineers for the proposed electric railway are said to have made arrangements for the Commencement of the work on the 1st of September.

Philadelphia, Pa.—Sealed proposals will be received until 12 o'clock noon, on Tuesday, Sept. 15, 1896, for electric lighting on board City Iceboat No. 3. Specifications for the work required and all necessary information may be had from the Superintendent of the boats, at the House of Correction wharf, near Holmesburg Junction, Philadelphia. Thompson M. Thompson, director.

New York City, N. Y.—Plans have been prepared for a one and five-story brick factory, to be erected on 12th avenue, east side, extending from 31st to 32d street, for David S. Brown & Co., Bank street and North River, to cost $150,000.

Halifax, N. S.—The city electrician is preparing an estimate of the cost of remodelling the fire-alarm system.

Chambly, Que.—The Chambly Water Power Company is coming to the front in earnest, and probably in a few weeks' time several hundred men will set at work to dam the Richelieu River at Chambly. Some time since this company gave a contract to the Stillwell-Bierce & Smith-Vaile Company, of Dayton, O., amounting almost to $1,000,000, the work to be handed over complete in the month of October, 1897. Tenders have also been invited for sub-contracts to the amount of $550,000, and they are expected to be opened within the next few days, and the fortunate tenderer started at once on this great undertaking.——M. F. L. Beique, Q. C., of Montreal, Que., is interested in the Chambly concern, as well as Mr. Holt, Presindent of the Montreal Gas Company. Power from Chambly will have to travel about fifteen miles to reach the city, but, as the Niagara Falls supply Buffalo with power 25 miles away, the distance from the Richelieu to the St. Lawrence is considered no obstacle to the success of the new undertaking. It is not yet decided whether the river will be crossed by using the Victoria Bridge or by cable, but the latter plan is so much more expensive that it will not probably be entertained.

Work will be begun as soon as the sub-contracts are decided upon, and a large amount of labor will be required during the fall and winter months.

NEW CORPORATIONS.

Sacramento, Cal.—Water, Electric and Power Company, of Los Angeles, has been incorporated, to construct dams, reservoirs, ditches, tunnels, lay pipes, to create power. Capital stock, $3,000,000, of which $7,000 has been subscribed. Directors: C. E. Brooks, W. H. Shinn, W. W. Everett, G.W. Bentley, A. E. Bagley, A. A. Stoiber and L. Friel, of Los Angeles.

Rochester, N. Y.—The Summerhays Company has been incorporated, to manufacture gas and electric fixtures and supplies. Directors: Marcus Hirshfield, Clara Lee Hirshfield and Charles B. Griffith, of Rochester.

Syracuse, N. Y.—The Syracuse Subway Company has been incorporated to construct electrical subways in Syracuse. Capital, $75,000. Directors: Eugent Hughes, William B. Kirk, Anson E. Aloord, and Hamilton S. White, of Syracuse, and John F. Gaynor, of Fayetteville.

San Francisco, Cal.—Pacific Coast Gas, Light and Fuel Company has been formed to operate gas works and sell gas and electricity for light and fuel and engage in general power business. Capital stock, $500,000, of which amount $2,500 has been subscribed. Directors: S. W. Van Syckle, W. B. Morris, Harvey J. Lewelling, Eli Lewelling, T. W. Nowlin.

Montreal, Can.—Notice of application for letters-patent of incorporation is given by the St. Jerome Power and Electric Light Company. Capital, $50,000.

San Francisco, Cal.—The Reger and Atwater Company has been incorporated to conduct a general electrical business. Capital stock, $25,000. Directors: P. A. Reger, W. M. Reger, Richard Wagner, Edward Wagner, and R. Knapp.

Albany, N. Y.—A certificate of the consolidation of the Manhattan Electric Light Company, Limited, and the Madison Square Light Company, of New York City, forming the Manhattan Electric Light Company, has been filed with the Secretary of State. Capital, $1,500,000. Directors: R. R. Bowker, E. A. Leslie, H. M. Edwards, and C. S. Shepard, of Brooklyn; and Frank Enos, of Englewood, N. J.——Star Electric Lamp Company, of Turners, Rockland county, has been incorporated. Capital, $50,000. Directors: John Silver, of New York City; Richard R. Moffat, of Brooklyn, and Geo. W. Mills, of Elizabeth, N. J.

TELEPHONE NOTES.

Albany, N. Y.—The Central City Telephone and Telegraph Company has been incorporated to construct lines connecting all points in Onondaga County, especially in Syracuse. Capital, $100,000. Directors: Eugene Hughes, Wm. B. Kirk, Hamilton S. White, B. S. Aldrich, Louis L. Waters, and Anson E. Alvord, of Syracuse, and John F. Gaynor, of Fayetteville.

Baltimore, Md.—The Standard Telephone Company was incorporated last Thursday to construct telephone lines from Crisfield to Pocomoke City, thence to Salisbury, Delmar, Laurel, Easton, Chestertown, Centreville, and Belair, with connections in Baltimore. In all about 250 miles of telephone line will be controlled.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued Aug. 4, 1896.

564,968. Rail Bond. F. E. Buxton, Worcester, Mass. Filed Nov. 29, 1895.

564,984. Device for Suspending and Supporting Trolley Wires. C. A. Fisk, Washington Court-House, O. Filed Feb. 23, 1895.

564,994. Subway for Electric Conductors. W. H. Hart, Brooklyn, N. Y. Filed May 20, 1896.

565,032. Electrical Governor. M. A. Replogle, Cedar Falls, Ia. Filed Jan. 26, 1894.

565,046. Telephone Switchboard. A. Stromberg, and A. Carlson, Chicago, Ill. Filed Oct. 29, 1895.

565,053. Electrical Fire-Alarm System. C. D. Tisdale, Boston, Mass. Filed Aug. 27, 1895.

565,056. Electro-Therapeutic Apparatus. H. E. Waite, New York, N. Y. Filed April 2, 1894.

565,080. Telephone Sub-Station Apparatus. A. de Khotinsky, Boston, Mass. Filed May 23, 1896.

565,085. Conduit for Electric Railways. C. D. Mattison, New York, N. Y. Filed Feb. 23, 1892.

565,086. Fire-Alarm Signal Box. G. F. Milliken, Boston, Mass. Filed April 2, 1891.

565,092. Electrolier. N. L. Root, C. L. Reed and D. C. Hale, Longmont, Colo. Filed March 13, 1895.

565,102. Electric Railway. H. Brandenburg, Chicago, Ill. Filed May 16, 1895.

565,103. Electric Railway. H. Brandenburg, Chicago, Ill. Filed Aug. 28, 1895.

565,128. Combined Typewriter and Telegraphic Transmitter. C. E. Yetman, Oak Park, Il. Filed Sept. 7, 1895.

565,136. Electric Sad-Iron. F. H. Date, J. Heffron, D. H. Scranton and J. Scudder, Detroit, Mich. Filed May 31, 1895.

565,138. Distribution and Regulation of Power. H. B. Gale, San Francisco, Cal. Filed June 17, 1895.

565,139. Method and Means for Electric Regulation of Power. H. B. Gale, New York, N. Y. Filed Jan. 15, 1896.

565,140. Electrode for Secondary Batteries. G. Hubner, Gernsbach, Germany. Filed June 24, 1895.

565,150. Train Despatcher's Chart Board. J. T. Williams, Brooklyn, N. Y. Filed April 30, 1896.

565,174. Trolley Wire Support. L. McCarthy, Boston, Mass. Filed July 20, 1894.

565,178. Electric Cable for Fire-Alarm Systems. H. A. Reed, Newark, N J. Filed Dec. 30, 1895.

565,188. Automatic Electric Fire-Alarm. C. D. Tinsdale, Boston, Mass. Filed July 11, 1895.

565,202. Combined Telephone and District Alarm System. F. Drake, San Francisco, Cal. Filed Sept. 26, 1894.

565,217. Cable for Electric Fire-Alarms. H. A. Reed, New York, N. Y. Filed April 20, 1896.

565,240. Underground Trolley System. R. E. Sherman and D. E. Kenyon, Chicago, Ill. Filed Nov. 12, 1895.

565,244. Circuit-Breaker. W. B. Tobey and H. W. Smith, Pittsfield, Mass. Filed Aug. 28, 1895.

565,284. Compound-Wound Polyphase Generator. B. G. Lamme, Pittsburg, Pa. Filed June 5, 1895.

565,344. Connecting Device for Electric Conductors. H. H. Gilmore, Easton, Mass. Filed March 7, 1896.

565,385. Telephoning from Cars. M. Carl, Akron, O. Filed Jan. 10, 1896.

565,407. Electric Locomotive. R. Eickenmeyer, Yonkers, N. Y. Filed Dec. 30, 1889.

565,410. Electrical Fire-Alarm System. J. D. Gould, Brooklyn, N. Y. Filed Aug. 27, 1895.

The Electrical Age.

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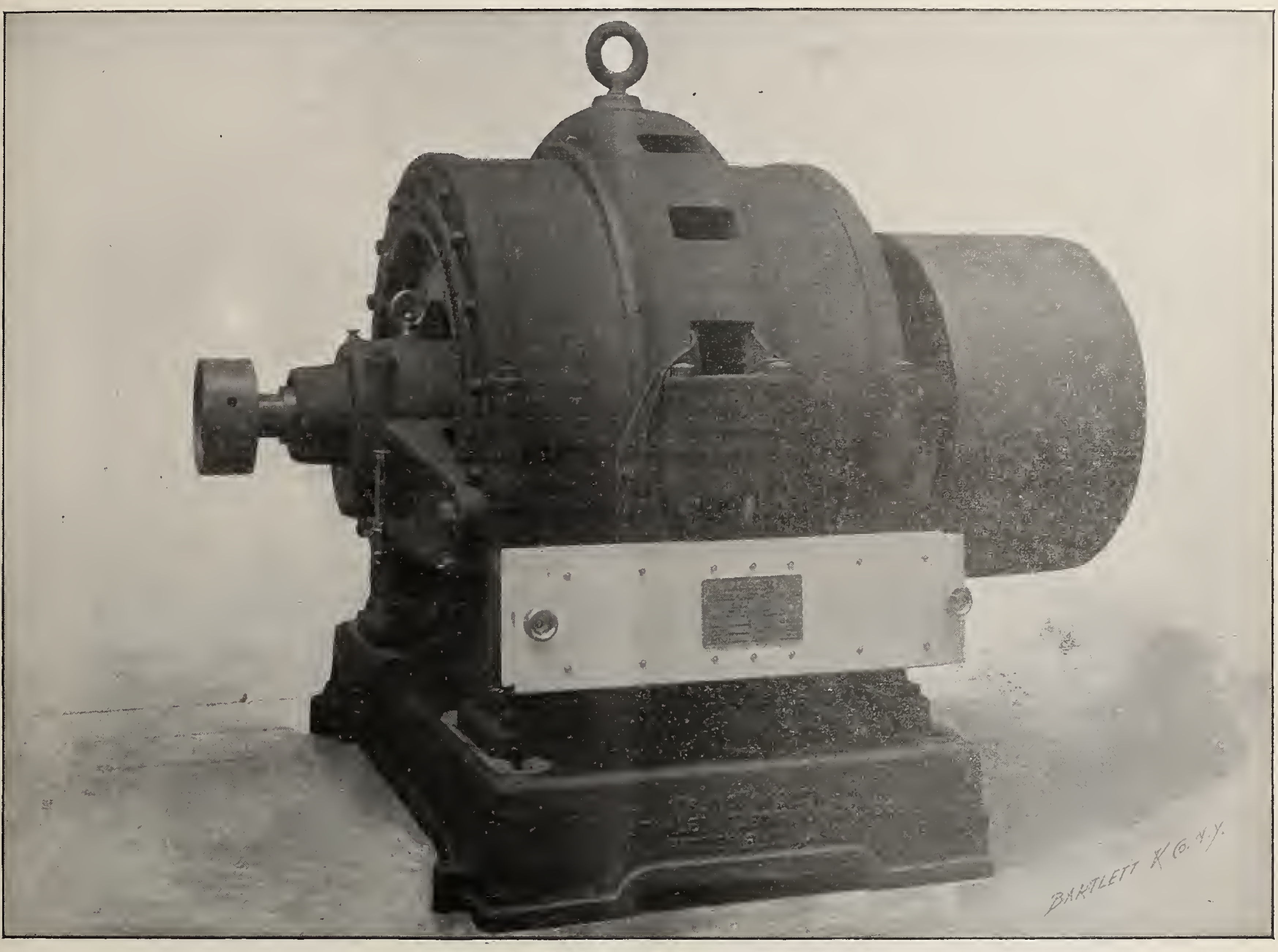


Seventy-Five-Kilowatt Alternating Current Generator.

THE DISTRIBUTION OF POWER.

The study of political economy has its bearing upon the welfare of the state. Prosperity is its first child and finance its prime minister. Many that have spent their money in electric light plants wonder at the success of others—theirs has been so limited the contrast is startling.

To those that have not realized even the usual return on a heavy investment we say, study the economy of your plant; regard it as the higher student does the land he lives in. If your machinery is active day and night and still the profit is negative, some great drain is occurring that must be and would be clearly evident to the discerning eye. Suppose the station is equipped as an alternating-current lighting plant. Is it likely that unless the dark-

ness of the Polar night prevails that much demand will exist during the day for current? Yet such would be the case if you supplied something that could be used. An electric equipment for public use should be competent to supply not only light but power. An alternating-current system cannot engage to do this *successfully* unless it generates a two or three-phase current. Power is distributed best from an alternating-current station as a multiphase current. The station then assumes the position of a benefactor during the day as well as night. The earnings of a company are bound to increase if this double function is performed. Yet many have persisted in declining to use this type of machinery.

A model station provided with a generator able to supply a current that can be used for power as well as light will be a small mint to the investors. No one can attempt to compete in the field of electric lighting unless the circuits may be tapped for power as well. A two or three-phase motor will toe the mark in this respect, and a station will then be of so superior a nature that its capacity for work will be almost doubled.

The most conservative attitude has been displayed toward this new and improved form of motor. It has run the gauntlet of adverse criticism unscathed.

The most enterprising companies are adopting this system of light and power by alternating currents. It is without doubt a great departure from the old and antiquated methods previously employed.

Marysville, Cal.—Marysville and Nevada Power and Water Co.; capital, $2,000,000; to generate electricity, etc. John Spaulding, Auburn; James O'Brien, Smartsville, and others.

Quebec, Que.—There are now about thirty men employed on the construction of the electric railway. The rails now being laid down in Dalhousie street are merely temporary ones, for the purpose of levelling the track, and will be replaced by the permanent rails, which are expected to arrive in the course of a fortnight.

NATIONAL ASSOCIATION OF POLICE AND FIRE TELEGRAPH SUPERINTENDENTS.

A very important movement is on foot to coalesce into one active and effective body all of the police and fire telegraph superintendents of the United States. The organization that has resulted from such an attempt will be a permanent institution, and have for its object the exchange and discussion of all facts bearing upon the construction and operation of police and fire telegraph systems. It has, in addition, that motive in view which has agglutinized many other associations into a powerful and influential body, and spread a feeling of binding relationship over all—the spirit of fraternity.

There is in all trades and professions a feeling of sympathy amongst the members of associated groups. Development that is both useful and progressive is the product of organized masses, and the common tie of like occupation knits together each to each by a firm and substantial bond.

The first meeting of the superintendents took place at Clarendon Hall, Brooklyn, September 15, 1896.

It may be said that the moving spirit that labored to bring about this meeting was Frank C. Mason, superintendent of the police telegraph of Brooklyn. About twenty-five people were present, and notices from superintendents in many other cities signifying their intention of joining the organization were received. When Mr. Mason called the meeting to order many representatives from the principal centres of the United States were in attendance. A temporary organization was formed with S. L. Wheeler, superintendent of fire alarm telegraph of Springfield, Mass., as chairman and L. Lemon, of Baltimore, as secretary. An executive committee was appointed to provide for a permanent association and draw up a constitution and set of by-laws. The gentlemen selected were E. S. Flanders, of Boston, W. Y. Ellett, of Elmira, Adam Bosch, of Newark, W. C. Smith, of New Haven, and Frank C. Mason, of Brooklyn. The invited guests

General View of Fire Alarm Headquarters, Brooklyn, N. Y.

present at this meeting had amongst their number some gentlemen well known to the electrical trade.

Fire Alarm Telegraph Co., N. Y.; H. Durant Cheever, manager Okonite Co.

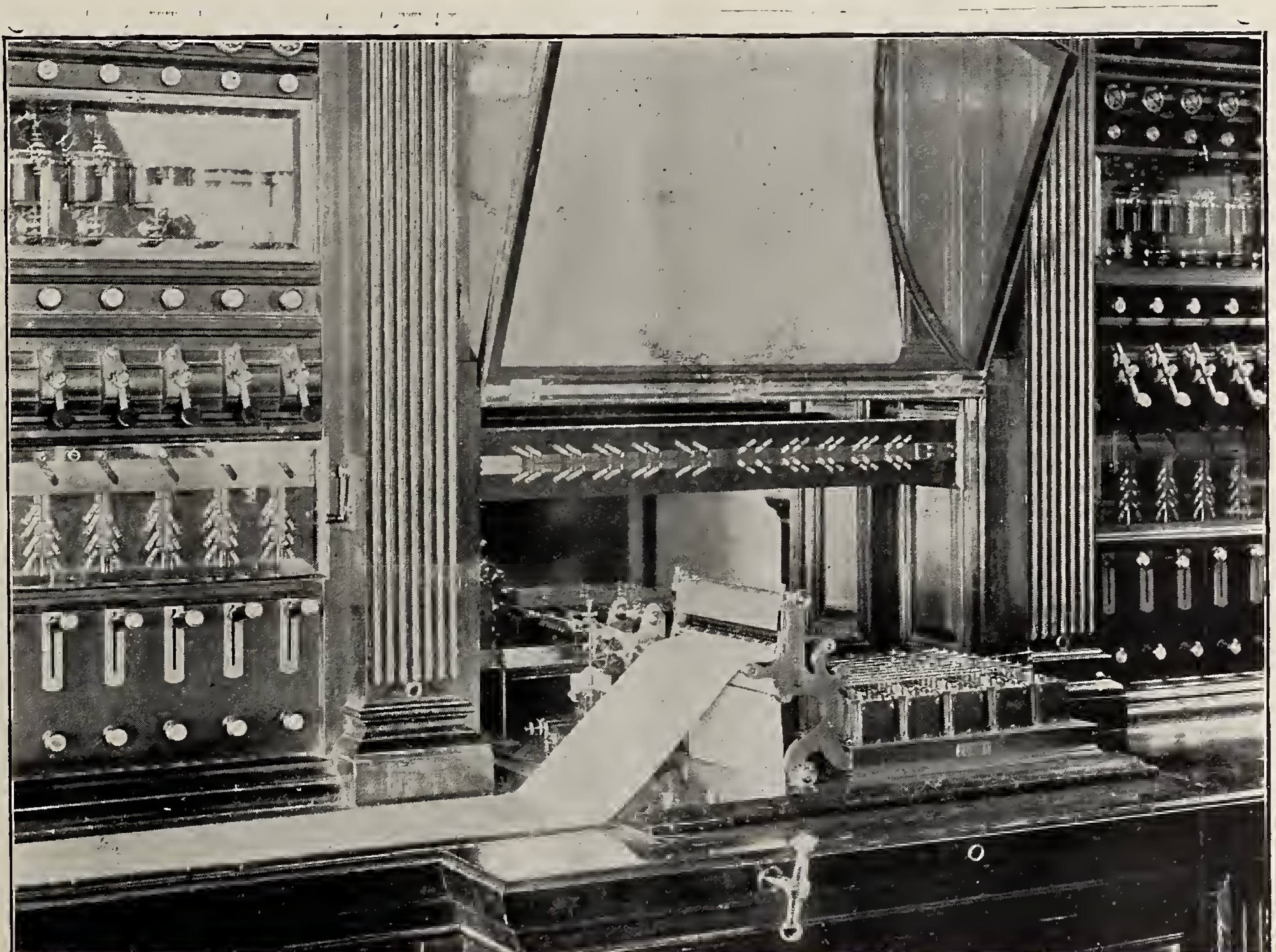
Mr. Frank Mason, Founder of the Association of Police and Fire Superintendents.

INVITED GUESTS.

C. E. Stump; L. W. Clark, of "Fire and Water," N. Y.; B. E. Greene, formerly of "Electricity," N. Y.; E. F. Peck, of Peck Electric Co., N. Y.; T. E. Crossman, stenographer, Brooklyn; W. T. Hunt, Electrical Age, N. Y.; M. W. Rayens; J. H. Emerich, Brooklyn; G. T. Manson, general superintendent Okonite Co.; P. M. McLaren, N. Y.; W. B. Green; T. Torrey, Gamewell

The labor of preparing a crude outline of the future work being over, the gentlemen adjourned to meet on the following day, Tuesday, at 10 A. M.

A group photograph was taken of the association. They marched in a body to the steps of the City Hall and assumed the most poetic attitudes possible under such circumstances. The strain upon their nerves was so great that in order to recuperate as quickly as possible



Multiple Pen Register and Part of Relay Cabinet, Brooklyn Fire Alarm Headquarters.

they took a train to Alderman Smith's Hotel, at Rockaway Beach. A few choice stimulants and a plunge in the surf made them all feel strong enough to attack a sumptuous repast.

Mr Mason was appointed toast-master, and discharged his duties with *eclat*. An ebullition of spirits existed on all sides, and a feeling of geniality pervaded the happy assemblage. Judge Green tickled their ears with great success. The theme he selected and dilated upon with eloquence was Daniel Webster. President Wheeler, Secretary Lemon, Comptroller Geo. H. Rowe, of Brooklyn, and others spoke as their feelings guided them, in all cases tersely and to the point.

Mr. C. E. Stump, well known to the electrical fraternity made a series of remarks in which he called attention to the great opportunities offered by an association of police and fire telegraph superintendents; how they could exchange views, read and discuss papers of vital importance, and examine more carefully into the nature of the mechanism used in various police and fire departments. The dinner, it may be noted, will be remembered as an event as pleasant to all as the first bright day in spring. The party returned to the city later in the day and, when evening approached, went to the theatre in a body. The fire headquarters, No. 365 Jay Street, Brooklyn, were visited and Superintendent Wafer explained the action of the apparatus in detail. The battery room was a marvel. The Gordon-Burnham cells created much attention; they had been on closed circuit for six months. The equipment in this station is one of the most perfect in existence. It was installed by the Gamewell Fire Alarm Telegraph Co. of New York.

National Association Police and Fire Telegraph Superintendents and Guests.

In the cuts the interior is represented as fully as possible. The gentlemen present were amazed at the wonderful accuracy and elaborate fittings of the automatic line tester and dial transmitter. The multiple pen register and main switchboard aroused many to an enthusiastic pitch.

The main switchboard is made in three sections. It is supported on a marble base, and arranged for sixty circuits; each respectively connecting to the engine house and steel boxes. An annunciator drop, which each circuit is supplied with, gives the line number that communicates the signal.

Automatic Line Tester and Dial Transmitter, Brooklyn Fire Alarm Headquarters.

A circular indicator on the top of the board enables the number of the circuit to be immediately determined.

A pair of test switches and galvanometer are provided for each circuit. When the circular indicator acts, the multiple pen register at once marks black and red; in red

ink if trouble has disorganized a circuit. There are fifty pens for black and one for red ink. Each circuit has a springjack operating connections and additional cells.

Each is likewise protected against crosses, grounds, earth circuits, etc. The line testing apparatus is automatic in its nature, indicating at once the existing trouble. The Gamewell Company have also installed a visual indicator and an Excelsior electro-mechanical gong. When a signal is sent, the box number sending it from the street is shown and likewise struck by the gong. Thus both eye and ear are called into play in determining the location of the fire.

The pleasure of witnessing this perfect piece of mechanism wound up the evening's entertainment.

The next day, which was the second day's session of the Fire and Police Telegraph Superintendents, the meeting took place as before at Hotel Clarendon, Brooklyn.

Chairman S. L. Wheeler called the meeting to order. W. L. Ellett of Elmira presented the points of the new by-laws and constitution as follows:

"The name of the association shall be the National Association of Fire and Police Telegraph Superintendents, and its office shall be at the place where the secretary resides.

"The officers shall consist of a president, vice-president and five others, who shall constitute the Executive Committee; also, a secretary and treasurer."

They were adopted in entirety and the election proceeded.

Mr. Mason was elected president.

Morris W. Mead, of Pittsburg, Pa., vice-president.

L. Lemon, of Baltimore, secretary.

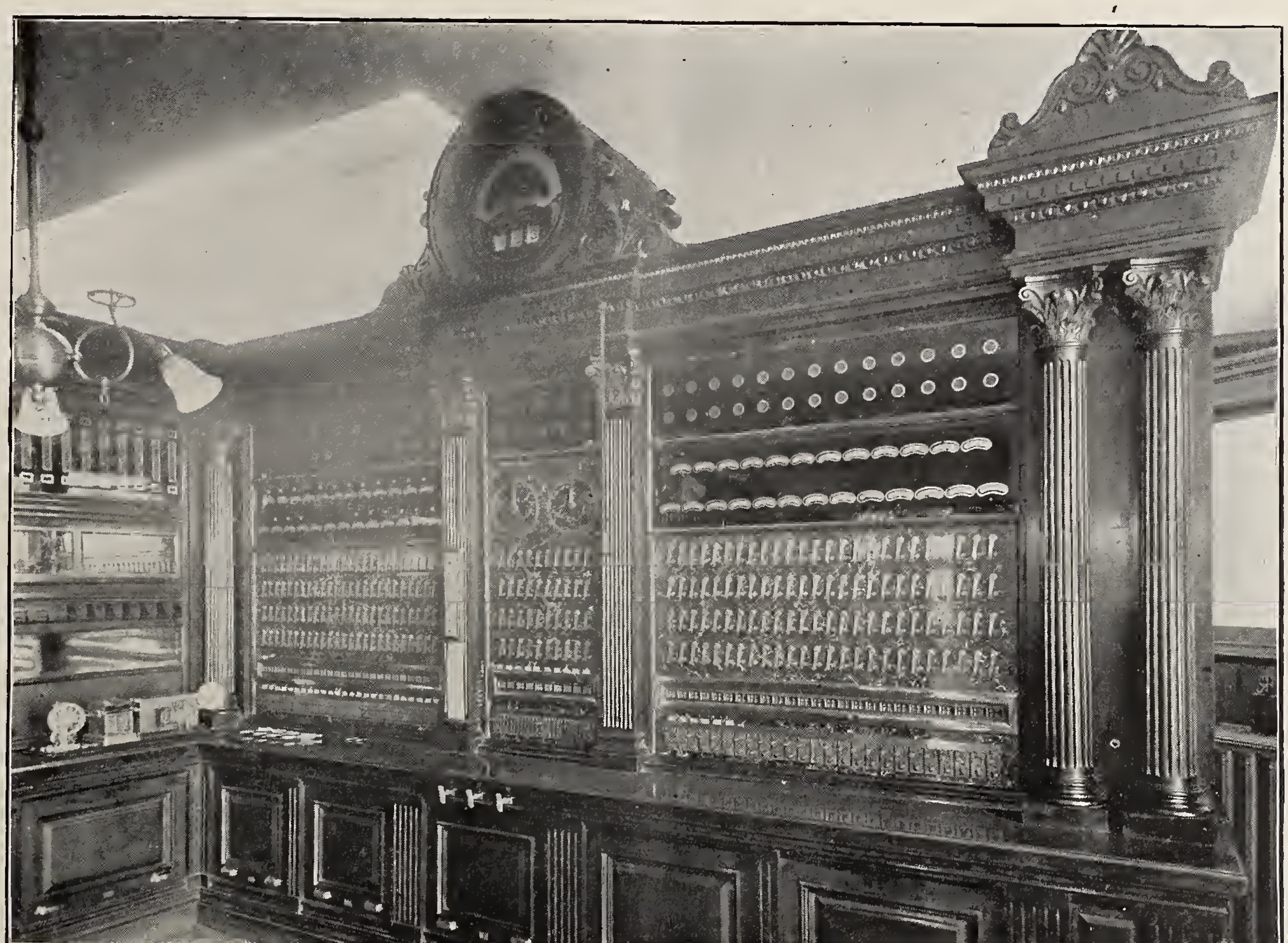
Adam Bosch, of Newark, treasurer.

Mr. Mason thanked the gentlemen present for the honor they had conferred upon him.

The permanent Executive Committee elected were composed of

John P. Barrett, Chicago, chairman.
William C. Smith, New Haven.
S. L. Wheeler, Springfield.
J. F. Zeluff, Paterson.
W. Y. Ellett, Elmira.

Charter members were made of those who had applied but were not present. Stenographer T. E. Crossman was thanked for his services. Mr. Mason was the recipient of a vote of thanks for his excellent work; the press likewise being remembered. The meeting adjourned, members inspecting the Twentieth Precinct



Main Switchboard Brooklyn Fire Alarm Headquarters.

"The object of this association shall be the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of fire and police telegraphic systems, and diffusion of this knowledge among the members of this association, with the view of improving the service and reducing its cost; and the establishment and maintenance of a spirit of fraternity among the members of the association.

"The active members of this association shall consist of superintendents of fire and police telegraphic systems of the municipalities and towns of America, and other persons having charge of municipal telegraph systems.

"The association members shall consist of all others connected with said police and fire telegraph systems, and those connected with appliances relating to such systems. Associate members shall not be entitled to vote.

Station House and enjoying themselves by a sail around Staten Island.

Among the delegates were F. P. Foster, of Corning, N. Y.; S. L. Wheeler, Springfield, Mass.; Charles F. Hopewell, Cambridge, Mass.; W. C. Smith, New Haven, Conn.; J. F. Zeluff, Paterson, N. J.; L. Lemon, Baltimore, Md.; William A. Barnes, Bridgeport, Conn.; W. Y. Ellett, Elmira, N. Y.; Adam Bosch, Newark, N. J.; John W. Sturr, Fire Commissioner of Paterson, N. J.; Moses Guntz, Police Commissioner of San Francisco, Cal.

Electric Carriage Race.—The race at Providence of Riker's electric carriage, and others of like nature, but different motive power, turned out favorably for Mr. Riker. He was awarded a prize of $900.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 527.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

The German Standard Candle (Vereinskerze).

THE METHVEN SCREEN.

Dibdin's results of tests of this standard are even less significant of what the standard will do from day to day under varying conditions than are his tests of candles, because here he compared two gas flames with each other, and they must have been similarly affected by varying atmospheric conditions. He found in his observations, which are given in his report of 1885, for determinations made by one operator, a maximum fluctuation of 5%, frequent fluctuations of from 2% to 3%, while 37% of the measurements were within 1% of the mean of all. From observations by three different operators, the maximum was found to be 6.7; many of the fluctuations were of from 3% to 6%, while 12.5% of the observations were within 1% of the mean. Using the carburetted gas, a result perhaps slightly better than the above was obtained, but with gas of varying purity he found large errors entering when the gas was bad. For example, a flame giving 18.50 candle-power when compared with the Methven burning 16-candle gas, gave when 10-candle gas was used in the Methven 31.30 candle-power, indicated in one test, and 22 candle-power indicated in another. This shows clearly that the variation of candle-power with the Methven is not a definite function of the richness of the gas, especially if the gas is poor. Dibdin's observations in this respect have been confirmed by the work of Rawson.[1] His conclusion is in contradiction to that of Heisch and Hartley, who found no variation whatever when the standard was supplied with gas running from 13.65-candle to 22.4-candle. Dibdin says: "These results . . . must seriously militate against the adoption of the plain gas Methven slit standard, however useful it may be as a handy instrument in ordinary works. The arrangement for carburetting is, on the other hand, a very different thing and capable of very reliable work." In his other report he says: "Observations with different operators cannot be considered as very satisfactory, for generally more experience with the carburetted gas is required than would appear necessary." In this second report he found for the deviations, using carburetted gas, a maximum value of 5%, while 74% of the observations were within 1% of the mean. He found also that bad results were obtained if the burner and chimney had not had time to become thoroughly warm before use. By using several chimneys of varying thicknesses, he found no serious error resulting from this cause.

1. Rawson: Electr., 17, p. 479, 1886.

Rawson[2] found in investigating this standard, that it was difficult to determine just when the flame height was three inches on account of the flickering of the flame. He found also changes in the rate of flow of gas when the eye could hardly detect any change in flame height. His observations show that the light emitted varies rapidly with changes in the quality of the gas when the gas is bad to start with. This is confirmed also by the work of the Dutch Commissioners, who found for the candle-power of the Methven standard, using 15-candle gas, 2.05 candle-power, while for 18-candle gas the candle-power was 2.23.

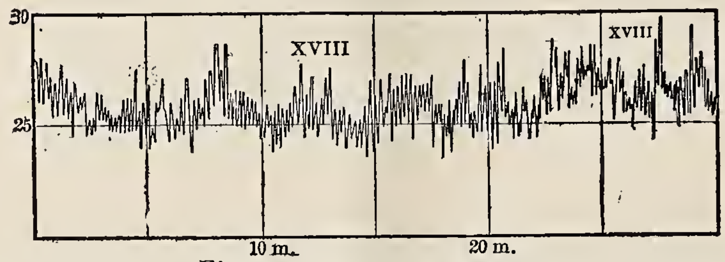


Fig. 11.—Methven Screen.

Methven[3] has discussed the effects of changes in temperature and pressure, on this standard. The effect of increased pressure and temperature is not to increase the size of the flame on account of more rapid flow of gas, but in burning denser gas in a denser atmosphere the size is diminished. With lower pressure and higher temperature the density of the flame is less, and the draught of the chimney is less. Less oxygen flows, and the flame takes on a brownish color. If the specific gravity of the gas is low, the intensity is much increased; if high, the increase is less marked. The draught is determined by the difference between the temperature of the room and of the flame, and hence for equal quantities of gas, and varying room temperatures the intensity will be different. A given gas gave 15.93 C. P. at 3°, 9 C; and 16.90 C. P. at 22° 2. This accords with the results of M. Bremond, who found for a given gas at different elevations above the sea-level a decrease in intensity of 0.742% per 100 feet increase in elevation. Moreover, the intensity is 10% less when the flame burns in moist air than when the air is dry. Coal-gas burning a Harcourt burner shows under similar circumstances a diminution of 13%.

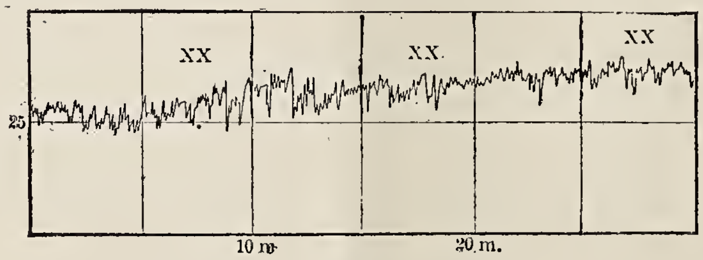


Fig. 12.—Methven Screen.

Figs. 11 and 12 exhibit specimens of the bolometric curves obtained by your committee in the case of the Methven screen. Curve XVIII. was taken with the Argand burner connected directly to the gas-pipes in the building. The pressure of the gas was controlled only by a large regulator on the main pipe leading into the build-

(Continued on Page 540.)

1. Rawson, loc. cit.

2. Methven: *Dingler's Polytechnishes Journal*, vol. 277, p. 276, 1890.

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CONTENTS.

	PAGE
EDITORIALS	
Three Cent Fares	539
Throwing Power Away	539
GENERAL SUBJECTS	
The Distribution of Power	533
National Association of Police and Fire Telegraph Superintendents	534
Standards of Light	538
Report on Rails for Street Railroads	540
The Transmission of Power	541
New York State Street Railway Association's Fourteenth Annual Meeting	542
TRADE NOTES	
Canadian Letter	547
Possible Contracts	547
Telephone Notes	548
NEW CORPORATIONS	547
New Telephone Companies	548
PATENTS	548

THREE CENT FARES.

President Rogers of the Street Railway Association has presented some very interesting facts to the public in the course of his speech before that body. It is commonly supposed that one of the best investments in this country is a trolley road. Those that own one are supposed to roll in wealth. Yet we hear that such extensive lines have to be laid to gain patronage that the yearly profits can only be prophesied. In other words, the howlers for three cent fares do not know that it will be years before the capital invested in electric lines will bring a proper compensation. Before competition and public demand we must all bow down. The trolley companies have been the first. We ought to be glad of the chance to pay five cents for a ride in a comfortable and speedy car. When the coffers of traction companies begin to bulge we shall hope to share in their dividends by asking for a three cent fare. Perhaps the following extract will help some of us to give them time.

"From the Railroad Commissioner's Report of 1895, I find that it has cost all roads of the State 91½ per cent. of their gross receipts for operating expenses, interest, taxes and rentals. Ninety-one and one-half per cent. of the five cent fares we receive is four cents, five and three-quarter mills, leaving but four and one-quarter mills profit for dividends. This fact should put at rest all question of cheaper fares. In New York city, one can legitimately ride twelve and one-half miles for five cents, transportation .004 per mile; in Brooklyn eighteen miles, transportation .0028 per mile, and in Buffalo, thirteen and three-quarter miles, transportation .0037 per mile. The street railway in the State of New York today affords the cheapest transportation in the world.

"No doubt we have all laid too many miles of track, from a dividend paying standpoint, but not for the convenience of our patrons. We may not be considered philanthropic, but we are, when prosperous and building for the future, more generous and far-sighted in our treatment of the public than would be warranted were there any further concessions to be demanded."

THROWING POWER AWAY.

When a man is extravagant they say he takes after his father. Without intending to be irreverent in the least, it cannot be doubted that a father of this kidney would leave but little for the son to take. Our present engineering is an example of the most frightful extravagance that has ever been recorded. We waste enough power to do our work ten times over. That is not all. We employ improved lighting machinery. When we want the effect of one pound of coal we are forced to burn a hundred. Let us see the truth of this. Take an electric light plant. Boiler and engine 12 per cent., dynamo 90 per cent., line 90 per cent., and lamp 10 per cent. What is the value of the remainder? About one per cent. Burn a ton of coal and you get the light of 20 pounds.

Understand that these figures are truthfully eloquent. Valuable machinery made by skilled manufacturers only enables us to reach this melancholy margin. It seems as though the loss is tremendous. Each transformation demands a heavy discount. It is lucky that nature is our bank, or the clerks we employ would soon make a call for our last throb of energy.

The Quality of Steel.—American steel consumers have lately been asserting that the steel and iron which are now produced are decidedly inferior in quality to what was formerly supplied. Several complaints, it seems, have been made from various large buyers about the quality of the steel rails which have been on the market during the last five years. On the other hand, the answers to this statement are numerous. One firm says that the rails of to-day are rolled from an ingot many times larger than that used a few years ago, and that the iron now put into the Bessemer steel is much more carefully graded and selected in its manufacture, and that in every way the article is vastly improved. Attention is also directed to numerous facts which may be responsible for the supposed deterioration, amongst which is the very pertinent remark that a great deal more is expected from the steel rail now than was ever expected from it in years gone by. It is said, and truly, that the 75-lb. rail used to-day is sustaining a great deal more in one month than the 56-lb. rail, which was used ten years ago, sustained in a whole twelve-month. The weight of locomotives has very largely increased, the freights are greater, and the speed is considerably higher. Consequently the rails are called upon to bear a great deal more strain than was ever the case ten years ago, and to do much more work. Rail manufacturers declare that they are keeping up with the times both in quality and quantity, and are able to meet all their demands in a satisfactory manner. However, there is an economical side to the question, and in cases where expenses have to be cut down, the use of material which is not of the very highest grade may result, and naturally, in the cry that steel rails are not what they were. If, however, the buyers want a first-rate article, they can always get it by the simple expedient of paying the extra price for first-rate goods. It is the same cry throughout.—Invention.

Professor Langley's Flying-Machine.—The daily press has recently contained accounts of a very successful trial of the model of an aerodrome or so-called "flying-machine," invented by Prof. S. P. Langley, secretary of the Smithsonian Institution. As is well known, Professor Langley has been quietly studying the problem of aerial navigation for some time. His present machine is only a model, though a very large one, and he evidently prefers trying actual flight with a small aerodrome to construct-

ing one of full size like Mr. Maxim's, and preventing it from leaving the ground. "The Age of Steel," May 16, speaks as follows of the experiments: "The aerodrome or flying-machine used is built of steel, and propelled by a steam engine. No less an authority than Alexander Graham Bell has given his signature to the statement that 'No one could have witnessed these experiments without being convinced that the practicability of mechanical flight had been demonstrated.' Professor Langley, in giving details of the aerodrome, says that it needs no gas to lift it and that the power is derived from a steam-engine through the means of propellers, but owing to the scale on which the actual aerodrome is built, there has been no condensing apparatus to use the water over and over. What was carried was only sufficient for but a brief flight, and the distance travelled was about one half-mile. The speed made at a recent trial was one-half mile or more in one and one-half minutes, or at the rate of about twenty miles an hour. If the aerodrome of Professor Langley has made the success reported, the fact is of importance and is likely to stimulate new endeavors in the same direction. It is possible we may be nearer practical aerial navigation than is generally supposed. It may not accomplish all that is predicted, but if once secured, the limits of its service would be hazardous to determine."—Literary Digest.

(Continued from page 538.)

ing. The consumption of gas in the building was constant during the run. The curve shows many large, but quick, variations and certain decided waves. The other Methven curve was taken with a gas-holder of about 10 gallons' capacity interposed between the gas main and the Argand burner. The effect of this in smoothing the curves is very marked and indicates that for photometric purposes the Methven screen is much improved by the interposition of a rather capacious reservoir. The use of such a reservoir tends to minimize the effect of changes of pressure and to absorb any waves in the gas due to water in the pipes or some similar cause.

The way in which these waves of variable pressure produce fluctuations in the amount of radiation, is by causing changes in the quality of those portions of the flame which cover the slit. At times the top of the flame becomes forked, so that not all of the slit is covered by it. It happens perhaps more frequently that some of the non-luminous portion of the flame rises so as partially to cover the slit. In either case the result is seen in a deviation of the curve. It must be true, also, that the amount of luminous radiation suffers a much larger proportional change than the total amount of radiation; hence the deviations recorded on the curves are too small to represent correctly the fluctuations in luminous intensity. There is an additional reason for these fluctuations, which is to be found in the slight protection against draughts of air which the wide open chimney used on the London Argand burner affords. In this respect its action is in marked contrast with that of the smaller close chimney of the Carcel lamp, which, of course, can be used only with much richer gases than ordinary illuminating gas.

(To be continued.)

REPORT ON RAILS FOR STREET RAILROADS.*

C. L. ALLEN, SYRACUSE.

In the construction and equipment of street railroads some particular specifications as to quality and finish of materials to be furnished are generally prepared. This is done for two reasons: First, to obtain material of a certain standard and quality and prohibit makers of cheap material or poor quality from bids; and second, to compare on a uniform basis the bids of different manufacturers. I may say that this is true of the construction of the lower plant, car houses, repair shops, cars and their equipment, over-head material, and to a certain extent in the construction of a track. We are careful to purchase ties of a certain kind, quality and size; spikes, of a particular kind and size, and to have joints of such a length, thickness and weight; the rails of a certain section, weight and height being specified; but as to the character and quality of the metal to be used in the rails and their appurtenances, nothing generally is said. In other words, we buy our rails, taking what the rail maker gives us, so far as quality of material is concerned. I do not condemn the rail makers or believe that there is any intention on their part to give railroad companies any material other than that which will be of good quality and finish; but the wear of traffic shows that there are certain defects in the rail; we naturally seek the cause and, if possible, the remedy. Some of our nine-inch rails, after traffic of two years, have shown such signs of wear, considering the length of time they have been laid, that after investigation we have concluded that rails of a harder quality of steel would not have shown the wear of traffic to such an extent.

Rails of hard steel, the analysis of which showed a greater percentage of carbon than the standard specification of rail steel, have been advocated by some of the steam railroad systems for some years, and I might add that their use has been a success in every way. The most notable instance of high carbon rails is that of the New York Central Railroad, upon the Hudson River Division near Spuyten Duyvil. These rails have been subject to as heavy traffic as any rails laid on this continent. They have been under traffic for nearly six years and up to this time, I believe, none have broken. When these rails were first delivered by the makers, so certain were they that the rails would become broken under traffic, that due warning was given the rail company by the makers that they would not be responsible for the damage which would most certainly occur from breakage. It was my good fortune early this year to consult with one of the firms of inspectors of steel in regard to the wearing quality of high carbon rails as compared with that of rails known as Bessemer rail steel, and their judgment was that high carbon rails will give from 40 to 60 per cent. greater life than rails of the standard Bessemer steel. When steam roads began to ask for street rails the composition of which called for high carbon, an extra price from $2 to $4 per ton was asked by the rail makers, but today these rails are obtainable for the same price as those of standard rail steel specification.

In Syracuse this year we are laying rails 60 feet in length, 9 inches high, and the half groove section. Our joint is ribbed or corrugated twelve-bolt, thirty-six inch joint. Our contract with the rail makers calls for rails the composition of which is as follows:

Carbon from .53 to 63.
Phosphorous not to exceed .095.
Sulphur not to exceed .07.
Manganese .80 to 1.00.
Silicon .10 to 12.

We have had five miles of track of this specification and are in hopes to lay this year twenty miles, and we are expecting great results from these rails. I have noticed that the wear on the head of the rail by car-wheels in the course of a month does not make any impression other than brightening the head of the rail, while in rail of standard specification I have seen under the traffic of two weeks' roll, the metal in the head of the rail to the outside of the head worn to a very perceptible degree. The fact that there is longer life to rails of hard steel will appeal to every street railroad man as an economy which cannot be sacrificed.

* Read before the meeting of the N. Y. State Street Railway Association.

THE TRANSMISSION OF POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Power is transmitted by means of
Steam,
Wire Rope,
Electricity,
Compressed Air,
Hydraulic Pressure.

The evident use of each is only to be determined by the existing conditions. At present but two have received such consideration as is required to lift them into prominence.

They are wire rope and electricity. In our busy towns and less settled suburban districts the trolley has been a great success, while the cable is limited in its application on account of the great expense of running and installation. The line must be drawn, however, between those systems which distribute and those which transmit power.

The distribution of power is carried on at the extremity of or along a power line. The transmission, between two distinct centres.

A line stretching from Niagara to New York would be a power transmission line; from the heart of New York to its innumerable streets and adjacent districts, merely distribution would occur. The case that would come more closely in touch with the title of this article would be that of two widely separated centres between which a line is to stretch carrying power from one to another.

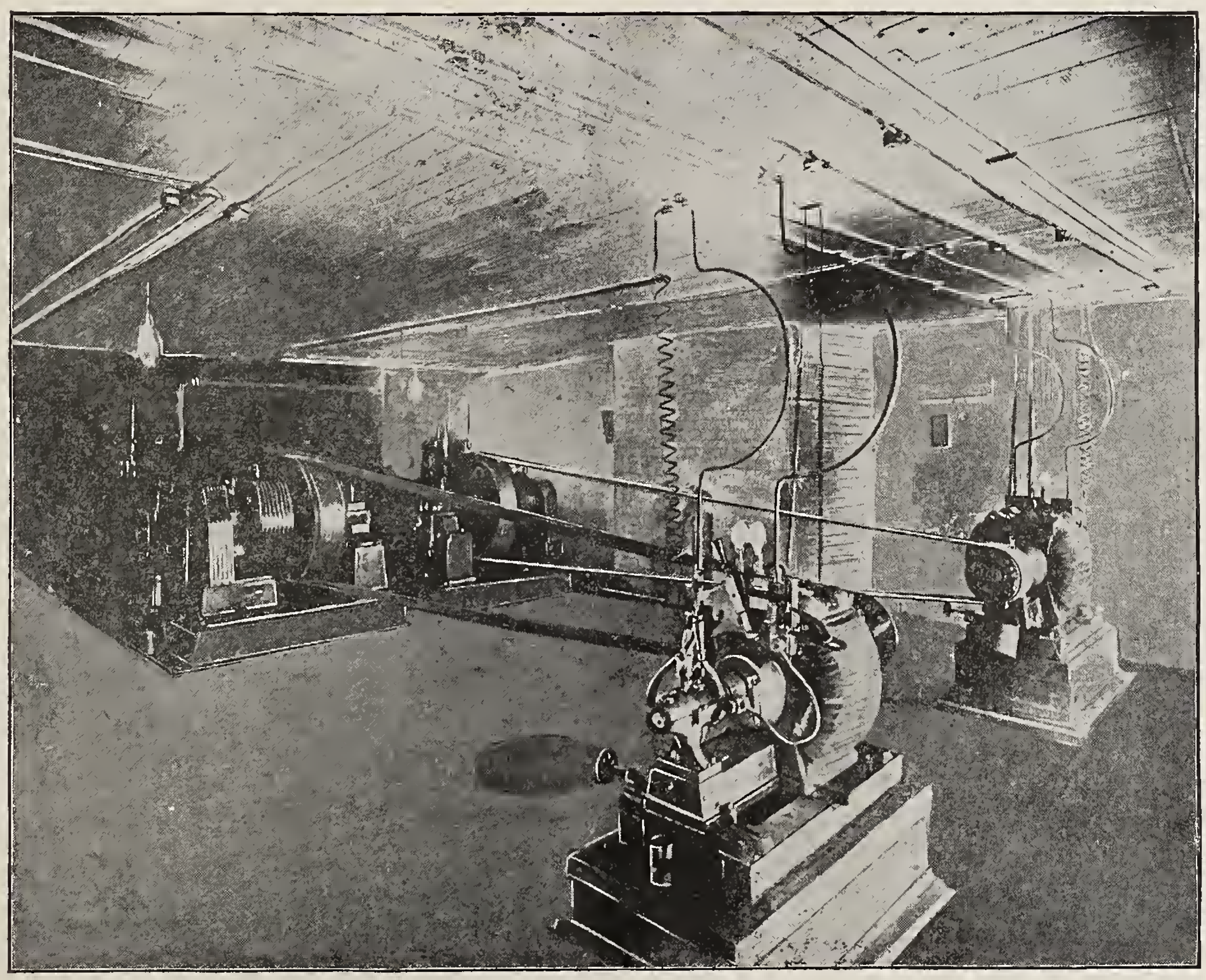
To determine the loss in power, weight of copper, volts required and general expense, is a problem having some weight in the transmission of power.

It is in reality all there is to the transmission of power, because it covers the most important points touching all things from the standpoint of economy.

If an electric current could be sent at random over any line without the least attention being given to insulation, pressure or current, then the subject of transmission of power would never have been dignified by such a title. It should be the object of every engineer to send power from point to point with the least possible waste and expense. This happy combination is only secured by investigating the conditions that exist. The efficiency of a system of transmission might be affected by the distance, locality, etc. For instance, the efficiencies of a wire rope transmission plant of the following distances are given by Kapp:

Distance in feet,	300	1,500	3,000	15,000	30,000	60,000
Efficiency	.96	.93	.90	.60	.37	.13

The same would naturally follow with any other source of power—that the greater the distance over which it extends, the greater the loss in power. As given by Herr Beringer and referred to by Gisbert Kapp, the following interesting table shows the relative efficiencies of each system:



Small Continuous Current Transmission Plant.

COMMERCIAL EFFICIENCY.

Distance.	Electric.	Hydraulic pressure.	Compressed air.	Wire rope.
300 ft.	69 per cent.	50 per cent.	55 per cent.	96 per cent.
1,500 "	68 "	50 "	55 "	93 "
3,000 "	66 "	50 "	55 "	90 "
15,000 "	60 "	40 "	50 "	60 "
30,000 "	51 "	35 "	50 "	36 "
60,000 "	32 "	20 "	40 "	13 "

Before 1891 these figures were compiled, and the line of electrical efficiencies is very much higher than the above today. It is not very difficult to send 1000 horse-power a distance of 100 miles, 528,000 feet, at an efficiency of over 60 per cent. As an example of the limitations imposed by distance and material, take a copper line having 10 per cent. drop, machines at each end of 90 per cent. efficiency—that is, motor and dynamo—what is the efficiency of the system?

The dynamo at 90 per cent. loses 10 per cent. in the line; there is 81 per cent. left for the motor. If the motor has 90 per cent. efficiency, it returns as power 90 per cent. of 81 per cent., which approximates 72 per cent. in total. What conclusion may be drawn from this other than that if motor, dynamo and line each have only 10 per cent. loss, the system is of 72 per cent. efficiency over any distance as long as these conditions with a continuous current are observed.

NEW YORK STATE STREET RAILWAY ASSOCIATION'S FOURTEENTH ANNUAL MEETING.

The fourteenth annual meeting of the Street Railway Association of the State of New York was held at the Bennett House, Binghamton, N. Y., Tuesday, Sept. 8, 1896.

John B. Rogers, Treasurer Binghampton Railroad Co.

J. P. E. Clark, Gen'l Manager Binghampton Railroad Co.

Hon. Geo. E. Green, Mayor City of Binghampton.

President G. Tracy Rogers called the meeting to order at 10:30, and Secretary Frick called the roll, when it was found that the following gentlemen were in attendance:

Delegates of Street Railway Companies.

C. Loomis Allen, superintendent track, Syracuse R. T. Ry. Co., Syracuse; J. P. E. Clark, manager, Binghamton R. R. Co., Binghamton; W. W. Cole, manager West Side R. R. Co., Elmira; H. S. Cooper, superintendent Schenectady Railway Co., Schenectady; R. E. Danforth, superintendent Buffalo, Bellevue & Lancaster Railway

Co., Buffalo; P. C. Deming, superintendent Buffalo Railway Co., Buffalo; H. C. Evans, Nassau Electric R. R. Co., Brooklyn; Benjamin Frick, Whitestone & College Point R. R. Co., Whitestone; Frank Gould, president Oneonta R. R. Co., Oneonta; William E. Haven, superintendent Citizens' St. Ry. Co., Fishkill; F. M. Hallock, director West Side St. R.R. Co., Elmira; H. H. Hallock, secretary West Side St. R. R. Co., Elmira; J. M. Johnson, secretary Binghamton R. R. Co., Binghamton; J. B. Lamfield, vice-president Binghamton R. R. Co., Binghamton; F.J. Maloney, Supt. Elmira & Horseheads R. R. Co., Elmira; John H. Moffitt, general manager Syracuse R. T. Ry. Co., Syracuse; F. P. Mooney, general superintendent Cortland & Homer Traction Co., Cortland; Ira McCormack, general superintendent Brooklyn Heights R. R. Co., Brooklyn; R. T. McKeever, general superintendent Fonda, Johnstown & Gloversville R. R. Co., Gloversville; Edmund O'Connor, counsel, Street

Giles S. Allison, St. Louis Register Co., New York; T. Beran,.General Electric Co., New York; William R. Billings, Taunton Locomotive Manufacturing Co., Taunton; H. W. Blake, "Street Railway Journal," New York; Paul T. Brady, Westinghouse Electrical & Manufacturing Co., Syracuse; Harold P. Brown, Plastic Rail Bond, New York; F.W. Bruckel, Johnson Company, New York; J. Coleman Boyd, New Haven Fare Register Co., New Haven; W. S. Calhoun, Brussells Tapestry Co., New York; W. J. Clark, General Electric Co., New York; Marston R. Cockey, John A. Roeblings' Sons Co., New York; C. A. Cockroft, Chenango Engineering Co., Binghamton; T. E. Crossman, stenographer, Brooklyn; H. H. Crowell, General Electric Co., Syracuse; Isaac N. Davis, life guard, Binghamton; A. B. Doolittle, flue cleaner, Binghamton; E. A. Dunning, representing A. O. Schoonmaker, mica, New York; W. A. Dutton, Dorner & Dutton, Cleveland; H. C. Evans, Johnson Co.,

Views in Ross Park.

railway Association, Binghamton; George T. Rehn, treasurer, Hornellsville Electric Ry. Co., Hornellsville; H. A. Robinson, vice-president Metropolitan Street Ry. Co., New York; G. Tracy Rogers, president Binghamton R. R. Co., Binghamton; John B. Rogers, treasurer Binghamton R. R. Co., Binghamton; C. L. Rossiter, president Brooklyn Heights R. R. Co., Brooklyn; F. O. Rusling, general manager Rochester Ry. Co., Rochester; E. F. Seixas, general manager, Amsterdam Street R. R. Co., Amsterdam; George H. Sliney, purchasing agent, Nassau Electric R. R. Co., Brooklyn; J. H. Stedman, transfer expert, Rochester & Irondequoit Ry. Co., Rochester; C.B. Storey, superintendent Hoosick Ry.Co., Hoosick Falls; Amos Van Etten, counsel, Kingston City Ry. Co., Kingston; Timothy S. Williams, treasurer, Brooklyn Heights R. R. Co., Brooklyn; James I. Younglove, Fonda, Johnstown & Gloversville R. R. Co., Johnstown. and others as follows:

New York; Arthur W. Field, Eastern Agent Peckham Motor, Truck & Wheel Co., Boston; C. R. Fitch, Erie Railroad Co., New York; C. Y. Flanders, Morris, Tasker & Co., Philadelphia; T. C. Frenyear, Westinghouse Electric & Manufacturing Co., Buffalo; J. A. Granger, New York Car Wheel Works, New York; W. C. Hawes, secretary Stow Manufacturing Co., Binghamton; C. R. Hammond, Delaware & Hudson Canal Co., Albany; G. M. Haskell, J.G. Brill Co., Philadelphia; C. F. Hotchkiss, president Stow Manufacturing Co., Binghamton; Thos. A. Hurley, Holmes, Booth & Hayden, New York; Newton Jackson, Electric Mutual Casualty Insurance Association, Scranton; F. O. Johnson, Stow Manufacturing Co., Binghamton; J. G. Jones, Hazelton Boiler Co., Carthage; Fred S. Kenfield, "Street-Railway Review," Chicago; E. J. Lawless, American Car Co., St. Louis; H. Jules Mailloux, "The Car," Philadelphia; J. F. Maguire, Erie Railroad Co., Elmira; S. Glen Meek, H. W.

Johns Co., New York; R. J. Mercur, New York Car Wheel Works, Buffalo; Willard M. Miner, Bi-Metallic Electric Transmission Co., New York; S. L. Nicholson,

Corner of Washington and Court Streets.

Cutter Electric Manufacturing Co., Philadelphia; E. Packer, Drummond Detective Agency, New York; L. H. Parker, General Electric Co., Schenectady; Mason D.

Main Street, West from Bridge.

Pratt, Pennsylvania Steel Co., Steelton; John S. Pugh, John Stephenson Co., New York; H. N. Ransom, Consolidated Car Heating Co., Albany; F. D. Russell, Rochester Car Wheel Works, Rochester; A. O. Schoonmaker; John A. Seeley, Belden & Seeley, New York; D. E. Sinn, Ramsey Signal System, Allegheny; —— Sjoberg, car wood work, New York; D. C. Sweet, wheel grinders, Springfield; John Taylor, Taylor Electric Truck Co., Troy; W. H. Taylor, "Street Railway Journal," New York; A. C. Vosburgh, New Process Rawhide Co., Syracuse; J. E. Wallace, Smith & Wallace, Boston; W. A. Washburne, Cambria Iron Co., New York; W. W. Wharton, Mutual Casualty Insurance Association, Scranton; A. C. Woodworth, Consolidated Car Fender Co.,

Providence; A. C. Woodworth, Jr., Consolidated Car Fender Co., Providence.

The next order of business being the approval of the minutes of the last meeting, on motion, they were ordered approved as printed.

President Rogers then read the following address:

We can point with pride to the work of our association as well as to the standing of the street railroads of our State. Each year tends toward better building and conservative managemet in all departments. While the roads of this State have made a decided gain in gross receipts during the past year, we more than realize not only the importance but the necessity of the most prudent and careful management.

The past year has not been marked by any startling or radical changes in the street railway world. The same tendency toward better building seems to prevail. The extension of roads into the country, the construction and adoption of high-speed motors and larger cars and the rolling and laying of 60-foot rails have all been tried successfully. The exercise of greater care in providing for the return current is to be observed, but perhaps the most important advance is in the universal adoption by large plants of the direct-connected generators; indeed, I am informed that over 80% of the generators produced during the past year are of this character.

The experience of the past year has demonstrated that where very long lines of street railways are to be operated, power can be economically delivered 20 miles or more from the power station by the three-phase system and the use of high-tension current. The experience of the past year has also demonstrated that with direct-current machines, longer lines than we had previously supposed can, by the addition of boosters, be operated economically. Some 15 or 20 different roads in the United States are now using this system.

The great city of New York, which should be at the head and front in all matters of progress and improvement, is forced to confess that she is far behind all other cities of the State in modern transportation facilities. The fact that she occupies this out-of-date position in respect to the construction of surface roads is not a reflection on the enterprise of the railroad interests of that city, but upon the municipality, because of the restrictions put upon the railroad people by the authorities.

The remarkable growth of traffic in New York City during the past 30 years and the necessity of the most improved facilities for transportation and the best possible method of traction is plainly illustrated in the following table:

In 1865, 11 street-car lines carried 79,618,818
In 1875, 13 street-car lines carried.......... 140,582,793
(With the elevated's first year, 3d and 9th avenues, 644,025.)
In 1878, 15 street-car lines carried 169,105,739
(With the elevated open on 6th and 2d avenues, 9,236,670.)

Entrance to Bennett Park.

In 1883, 15 street-car lines carried .... 266,164,23[illegible]
(With elevated carrying 92,124,943.)
In 1893, 16 street-car lines carried .... 453,652,96[illegible]
(With the elevated carrying 219,621,017.)

From the Railroad Commissioner's report of 1895, I find that it has cost all roads of the State $91\frac{1}{2}$% of their gross receipts for operating expenses, interest, taxes and rentals. Ninety-one and one-half per cent of the 5-cent fare we receive is $4.5\frac{3}{4}$ cents, leaving $4\frac{1}{4}$ mills profit for dividends. In New York City one can legitimately ride $12\frac{1}{2}$ miles for 5 cents; transportation, 0.004 per mile; in Brooklyn, 18 miles, transportation 0.0028 per mile, and in Buffalo, $13\frac{3}{4}$ miles, transportation, 0.0037 per mile. The street railway in the State of New York to-day affords the cheapest transportation in the world.

The question of fenders is still confronting us, and is a most perplexing problem. More patents for street-car fenders have been granted during the past few years than for any other class of inventions. It is stated upon good authority that there are upwards of 4,000 on the market. It is the opinion of many street-railway men that the fender is a menace.

Your Executive Committee were anxious that an act be passed regarding fenders. There were a number introduced. The one introduced by the chairman of the Assembly Railroad Committee seemed to meet the approval of the public and was heartily indorsed by your Executive Committee, but for some reason it never became a law. The street railways are anxious that the State should share some of the responsibility. I stated last year, and still believe, that the best fender for the front end of a car is a clear-headed motorman.

No question is of greater importance to the street railway companies and the manufacturers of equipment and electrical apparatus than that of having some definite standard as regards the rating of motors and generators and as regards the features involved in application of the same, such as diameter of car axle, wheels, heigh

of car body from track, etc. The steam roads of the country have done much towards fixing standards and rendering interchangeable material and parts. This gives to the railways, aside from all other advantages, a cheapened cost to the manufacturer, and consequently to the road, due to the reduction of the number of different parts and sizes. These and many other points which will suggest themselves apply even more forcibly to street railways than to steam railroads.

The pleasant relations now existing between the steam railroad and street railway companies of this State are a subject of congratulation, although in many instances the interests are conflicting.

After the routine business had been attended to the reading of papers, the real object of the convention, was taken up.

"The Use of Transfers" was the subject of the paper by J. H. Steadman, of Rochester. He took the ground that if properly guarded a liberal transfer system would pay companies. C. Loomis Allen, of Syracuse, discussed the question of "Special Track Construction." W. W. Cole, of Elmira, read an interesting paper on the subject "How Can We Prevent Accidents and Get the Most Out of Employees?" H. S. Newton, of Syracuse, sent a paper on "Power from the Trolley Circuit; Is it Practical? Why do Insurance Companies Object to It?" The paper was read by Mr. Allen. "The Daily Inspection of Cars and Repairs," was the subject of a paper by J. W. Calhoun, of Elmira. In his absence it was read by J. P. E. Clark, of this city. A paper on the establishment of a board of claims was read by A. S. Cooper, of Schenectady.

At the banquet in the evening, held in Hotel Bennett, the following toasts were responded to:

"City of Binghamton," George E. Green, Mayor; "Our Hosts: The Binghamton Railroad Company," W. W. Cole; "Our Lady Riders," Joseph M. Johnson; "Our Pro and Con Friends—The Lawyers," Hon Edmund O'Connor; "Our Dearest Foe and Our Warmest Ally—The Press," Col. Sam. Payne; "Our Friends who Keep Us Guessing—The Legislature," Hon. C. F. Tupper, "Children of a Larger Growth—The Steam Railroads," C. D. Hammond. J. H. Stedman, toastmaster, Rochester.

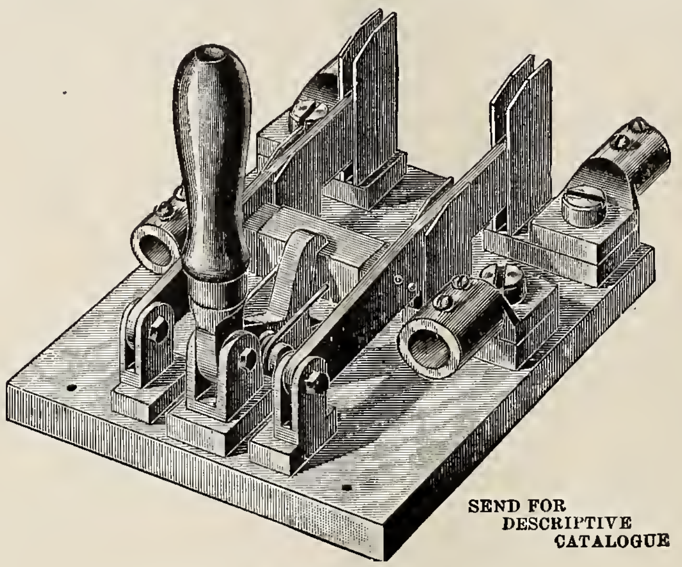
The tables were decorated with palms and flowers. In the centre of the room on a small table was a miniature trolley car made of sugar. It was numbered 90 and on the side were the words "Binghamton Street R. R. Co." An orchestra was stationed in an alcove and furnished music during the progress of the banquet.

Election of Officers.—President, G. Tracy Rogers, Binghamton, N. Y.; First Vice-President, W. Caryl Ely, Niagara Falls, N. Y.; Second Vice-President, John N. Beckley, Rochester, N. Y.; Executive Committee—H. H. Vreeland, New York, N. Y.; John W. McNamara, Albany, N. Y.; Henry M. Watson, Buffalo, N. Y.; C. L. Rossiter, Brooklyn, N. Y.; Secretary and Treasurer, H. A. Robinson, New York, N. Y.

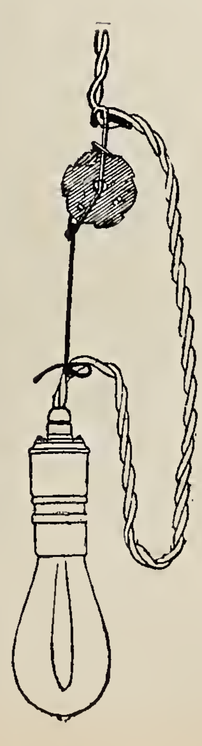
On motion of Mr. Moffitt, a vote of thanks was tendered to ex-Secretary Frick for the able and efficient manner in which he discharged the duties of his office during the past year.

The meeting then adjourned to meet at Niagara Falls the first Tuesday in September, 1897, and the delegates started for a trolley ride to Ross Park, State Hospital and other local points of interest, terminating with a ten-mile ride to Union.

The Nassau Electric Mfg. Co.—Mr. F. B. Sharp has been appointed manager of the Nassau Electric Manufacturing Company, Nos. 127, 129 and 131 25th street, Brooklyn, N. Y. Mr. Sharp is as bright, vigorous and full of work as ever. His company is fully prepared to fill all orders promptly; they have a large, well-lit shop, the newest of machine tools, and a force of men able and ready to handle the largest switchboard ever demanded. The Nassau Electric Manufacturing Company make the famous "Baehr" quick-break switch. With Mr. Sharp as manager, and so able and experienced a business man as Mr. Cahill at its head, the Nassau Electric Manufacturing Company will reap prosperity. Our friend, Mr. Cahill, was the proprietor of the Solar Electric Manufacturing Company; it coalesced with the Brooklyn Electric Manufacturing Company, of which Mr. Sharp had previously been manager. The Nassau Electric Manufacturing Company, in addition to the Baehr switch, manufacture switchboards and electric specialties. It might be of the greatest benefit to some of our readers to call and see their shop and its equipment. Every courtesy will be extended to visitors from the trade. Their shop can toe the mark in making all sorts of fine work, and it will be well to see them if you have anything in view. They have a machine which will bend pipes to any shape desired, whatever the dimensions.



Baehr "Quick-Break" Switch.



The Sharp incandescent lamp adjuster, sold by the Sharp Electric Mfg. Co., No. 286 290 Graham street, Brooklyn, N. Y., is an exceedingly convenient and useful addition to the home, office or factory. They are doing a flourishing business with it and believe it to be solely due to the simplicity and excellence of the article they sell. It is a simple and perfect working double-catch that will hold any weight of lamp or shade. It is perfectly insulated, attached to the flexible cord by insulating fibre, and can be put on by any one in half a minute. It is secure and good. Write for one and try it. Send 12 two-cent stamps.

Chas. A. Schieren & Co.—The Southern Electric Light & Power Co., Philadelphia, Pa., have in use throughout their station Schieren plain and perforated belts. They are of three-ply thickness for heavy belting and perforated for the dynamos. Manufactured by Chas. A. Schieren & Co., Cliff and Ferry streets, New York.

Mr. Max Osterberg, E. E., A. M., has opened offices at No. 27 Thames street, New York. His work will include consulting, expert work of all kinds and a specialty of gas engine plants. There is a great future for the man that puts his foot squarely into the midst of legitimate enterprises and becomes known as an authority. We wish Mr. Osterberg every success.

CANADIAN LETTER.

Montreal, Que.—The Lachine Rapids Hydraulic and Power Company are rushing things, as there are no less than 875 men employed on the several portions of the gigantic undertaking. An important contract has just been closed with the National Underground Cable Company, of New York, by which the latter agrees to lay 507,000 lineal feet of concrete-lined iron duct, the contract price being about $150,000. Apart from this the company has given out contracts valued at $1,500,000, and Messrs. J. B. St. Louis and Shearer have begun the erection of a pressed brick receiving station at the corner of Seminary and McCord streets. From the Rapids to the receiving house wires will be strung on steel poles, while in some streets, where the underground line is laid, no less than sixty-six pipes will be brought into use, and at other places there will only be four.

The contract for the concrete dam, power-house and rock excavation in connection with the Chambly Water Power Co. has been awarded to Messrs. Peter Lyall and Sons. There were eight or nine tenders and the majority of them came from the Western States. The Messrs. Lyalls' contract is from $300,000 to $400,000, and will be begun immediately and carried on all winter, the entire work to be completed by October, 1897.

Sherbrooke, Que.—Messrs. Jacob Laroche, C. G. Brouilette, of Sawyerville; Joseph Lemieux, of St. Malo; Alfred Adam, of Paquetteville; P. A. Barbeau, of Cookshire; G. Bedard, of Sherbrooke, Province of Quebec, have been incorporated by the name of The Canadian Telephone Company, with a total capital stock of $10.-000.

Peterboro, Ont.—It has been decided by the city council to invite tenders for lighting the streets of this city by electric light. A five years' contract will be granted.

Toronto, Ont.—The Ontario Government is considering the advisability of installing an electric light plant in the Central Prison. The question of putting in a plant at the Asylum at Brockville is also being considered.

Vancouver, B. C.—The city council have approved of the route of the proposed Vancouver and Victoria Eastern Railway and Navigation Co.'s line, and will request the government to grant financial assistance towards the construction of the road.

Toronto, Ont.—The Mayor will shortly lay before the council a message favoring the construction of the extension of the street railway system to the Island, by way of Queen's Wharf and the sand bar, by means of a bridge.

Walkerton, Ont.—Mr. A. Brunel, engineer of the Huron and Ontario Electric Railway, has presented his report on the route. A number of waterfalls are to be utilized for power purposes, and several bridges will be erected over the Saugeon and other streams.

J. Alcide Chausse.

POSSIBLE CONTRACTS.

Baltimore, Md.—The county commissioners have contracted with the Edison Electric Illuminating Company of Baltimore City to light with electric arc lights some of the streets, highways and lanes of Baltimore county for a period of five years at 35 cents per night for each light. The lamps are to be 2,000 candle-power each and will burn all night.

Lewiston, Me.—Cobb's Hotel is to be newly equipped with steam, heat, electric lights and electric bells.

Paterson, N. J.—A large factory is in course of construction at Hawthorne, where electrical supplies will be manufactured. New York business men living in Ridgewood are interested in the enterprise.

Philadelphia, Pa.—Cope and Stewardson, architects, have finished preliminary sketches for a college building to be erected at Princeton, N. J., for the College of New Jersey. The building will be three and a half stories high. The cost of the building, including all sub-contracts, will be $100,000.

Cincinnati, O.—Mrs. Loretta Gibson is going to build a flat house in Mt. Auburn, near Boman's Place. It will be composed of brick and stone, fitted up with its own heating and electric light plant, and will cost not less than $250,000. Boll & Taylor are the architects.

Siloam Springs, Ark.—The construction of water-works and an electric light plant is being talked of.

Fernandina, Fla.—The city has the erection of an electric light plant under consideration. Address the mayor.

St. Petersburg, Fla.—Plans are being made for the proposed electric light and water plant by A. P. Miller of Tarpon Springs. The electric plant will start with 600 lights.

Cuthbert, Ga.—The proposed issuance of $7,000 in bonds for the erection of an electric light plant will be voted for on September 18. Robert L. Moge, mayor.

Washington, D. C.—The Metropolitan Street Railway Co. has issued $200,000 in bonds for equipping the road.

Marlin, Tex.—Messrs. Welle and Schimming have asked for a franchise for putting in an $8,000 electric light plant.

Mt. Crawford, Va.—Messrs. Myers and Funkhouser want to buy a second equipment for an electric light and power plant, including engines, pulleys, belting, etc.

NEW CORPORATIONS.

San Francisco, Cal.—Fraser Electric Elevator Company has been incorporated to manufacture devices and structures covered by latest patents. The principal place of business is to be San Francisco, and the directors are as follows: Ethelbert M. Frazer, George Crocker, Charles E. Green, John J. Mahony and A. J. McNicoll, all of San Francisco. The capital stock is to be $100,000.

Albany, N. Y.—The Richmond County Electric Light Company has been incorporated to operate in the cities, villages and towns of Richmond county. Capital, $200,000. Directors, Edward P. Doyle, of Northfield, S. I.; George B. M. Harvey, John P. O'Brien, of New York City; Arthur D. Chandler, of Orange, N. J., and John E. Comins, of Arlington, N. J.

Baltimore, Md.—Southern Electric Co. has been incorporated by J. F. Morrison, P. Winsor, J. S. Boyd, H. R. Preston, of Baltimore, and A. G. Glazier, of Boston. Capital stock, $70,000. To deal in electric supplies, etc.

San Antonio, Tex.—The Mutual Electric Light Co. has been incorporated by J. P. Green, F. A. Piper and W. W. King, with a capital stock of $50,000, to manufacture and sell electric light and power.

San Francisco, Cal.—C. T. Sinclair, G. L. Ecker, W. B. Taylor, H. C. Ward and A. H. Ward have incorporated the Mariposa Electric Power Co.

TELEPHONE NOTES.

Brownwood, Tex.—D. J. Denton has received the contract for the construction of the line of the St. Andrew's Bay, Chipley and Vernon Telephone Co., of St. Andrew's Bay, Fla.

Dunkirk, N. Y.—The Council adopted a resolution granting a franchise to the Automatic Telephone Company, the company to be required to use symmetrical poles well painted.

NEW TELEPHONE COMPANIES.

St. Andrew's Bay, Fla.—The St. Andrew's Bay, Chipley & Vernon Telephone Co. has organized. The officers are as follows: A. J. Gay, of Gay, president; T. W. Hentz, secretary, and L. M. Ware, treasurer, of St. Andrew's Bay.

Tacoma, Wash. —The Metropolitan Telephone and Messenger Co. has been incorporated by R. T. Reid, G. F. Whitty, A. J. Hayward, G. W. Bird, S. S. Loeb, B. Mayses and A. F. Eastman, with a capital stock of $10-500, to do a general telephone and messenger business under a franchise recently granted by the city;

ELECTRICAL and STREET RAILWAY PATENTS.

Patents Issued August 11, 1896.

565,453. Electric Railway. Wm. Gounow, Jr., Bridgeport, Conn. Filed August 27, 1895.

565,518. Railway Crossing Signal. J. Shoecraft, Harveyville, Kansas. Filed September 17, 1895.

565,529. Dynamo-Electric Machine. E. Caemmerer and F. G. Mayer, Chicago, Ill. Filed December 4, 1895.

565,530. Dynamo-Electric Machine. E. Caemmerer and F. G. Mayer, Chicago, Ill. Filed December 4, 1895.

565,541. Socket for Incandescent Lamps. H. Hubbell, Fairfield, Conn. Filed June 6, 1896.

565,571. Electric Cigar Lighter. F. W. Schindler-Jenny, Kennelbach, Austria, Hungary. Filed October 2, 1895.

565,574. Electric Heater. R. Van R. Sill, Cleveland, O. Filed March 20, 1896.

565,624. Electric Conduit Railway. J. B. Linn, Cleveland, O. Filed January 11, 1895.

565,627. Telephone Exchange System. A. F. W. Meyer, Blue Island. Filed August 8, 1895.

565,647. Armature for Dynamo-Electric Machine. D. P. Thomson and A. H. Armstrong, Schenectady, N. Y. Filed May 13, 1896.

565,657. Photographic Telegraph Recorder. C. Ader, Paris, France. Filed October 24, 1895.

565,662. Electric Switch. C. Bach, Jr., Milwaukee, Wis. Filed November 11, 1895.

565,672. Rail-Bond. F. H. Daniels, Worcester, Mass. Filed June 20, 1896.

565,673. Electric Switch. W. L. Denio, Rochester, N. Y. Filed January 25, 1894.

565,725. Trolley-Wheel. J. B. Dailey, Philadelphia, Pa. Filed October 22, 1895.

565,727. Charging and Discharging Secondary Batteries. E. N. Dickerson, New York City. Filed May 26, 1892.

565,739. Electrically Operated Stringed Musical Instrument. W. H. Gilman, Boston, Mass. Filed July 21, 1894.

565,740. System of Electrical Distribution. F. D'A. Goold, New York City. Filed November 2, 1895.

565,741. Storage Battery System. F. D'A. Goold, New York City. Filed February 27, 1896.

565,761. Electric Time Alarm. H. E. Lipscomb, Va. Filed June 18, 1896.

565,775. Advertising Electrical Phosphorescent Letters or Signs. D. McF. Moore, New York City. Filed January 7, 1895.

565,776. Phosphorescent Electrical Illumination by Metallic Coating Upon Glass. D. McF. Moore, New York City. Filed January 24, 1895.

565,777. Phosphorescent Electrical Illumination by Secondary Currents. D. McF. Moore, New York City. Filed January 24, 1895.

565,811. Switchboard for Electrical Distribution Systems. L. B. Stillwell, Pittsburg, Pa. Filed August 6, 1895.

505,823. Multiple Switchboard. R. McAndrews, Richmond, Va. Filed April 17, 1896.

565,839. Automatic Signal. J. P. Coleman, Edgewood Park, Pa. Filed June 1, 1896.

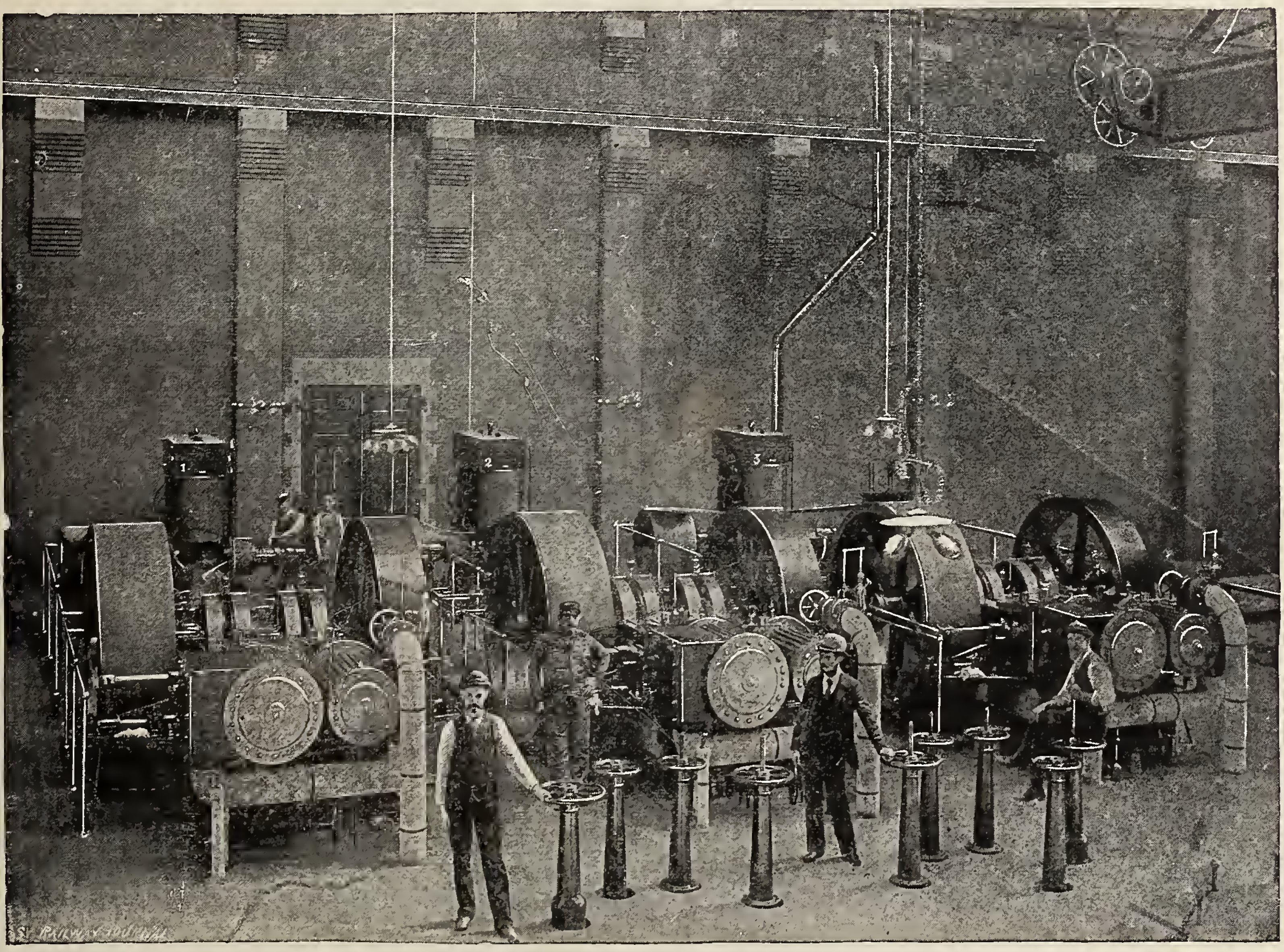
565,861. Electric-Arc Lamp. J. A. Mosher and William S. Bartholomew, Chicago, Ill. Filed September 23, 1895.

565,862. Fitting for Incandescent Electric Lamps. J. McFarlane, Glasgow, Scotland, and W. B. Edgar, Partick, Scotland. Filed June 27, 1894.

565,867. Cut-Out for Electric Motors. E. P. Warner, Chicago, Ill. Filed March 5, 1895.

The Electrical Age.

Vol. XVIII., No. 13. NEW YORK, SEPTEMBER 26, 1896. Whole No. 489



An Early Edison Transmission Plant—Generating Station.

THE TRANSMISSION OF POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The latest feat of engineering has been the design and construction of a huge power plant at Niagara Falls. In Germany, between Frankfort and Lauffen, a line 100 miles long was extended. The power was generated at Lauffen. A turbine that gathered energy from the Necker River was used and a three-phase alternator.

The current generated was 1400 amperes at 50 volts pressure. It was transformed before entering the line to 30,000 volts, and when received at the other end (Frankfort) again reduced to 60 volts. According to an official test, when 80,500 volts were sent out 58,000 were received; the efficiency being 72 per cent. This account of what may be considered the first experiment of any consequence in this direction gives satisfactory results.

The distance over which the power was transmitted was 108 miles.

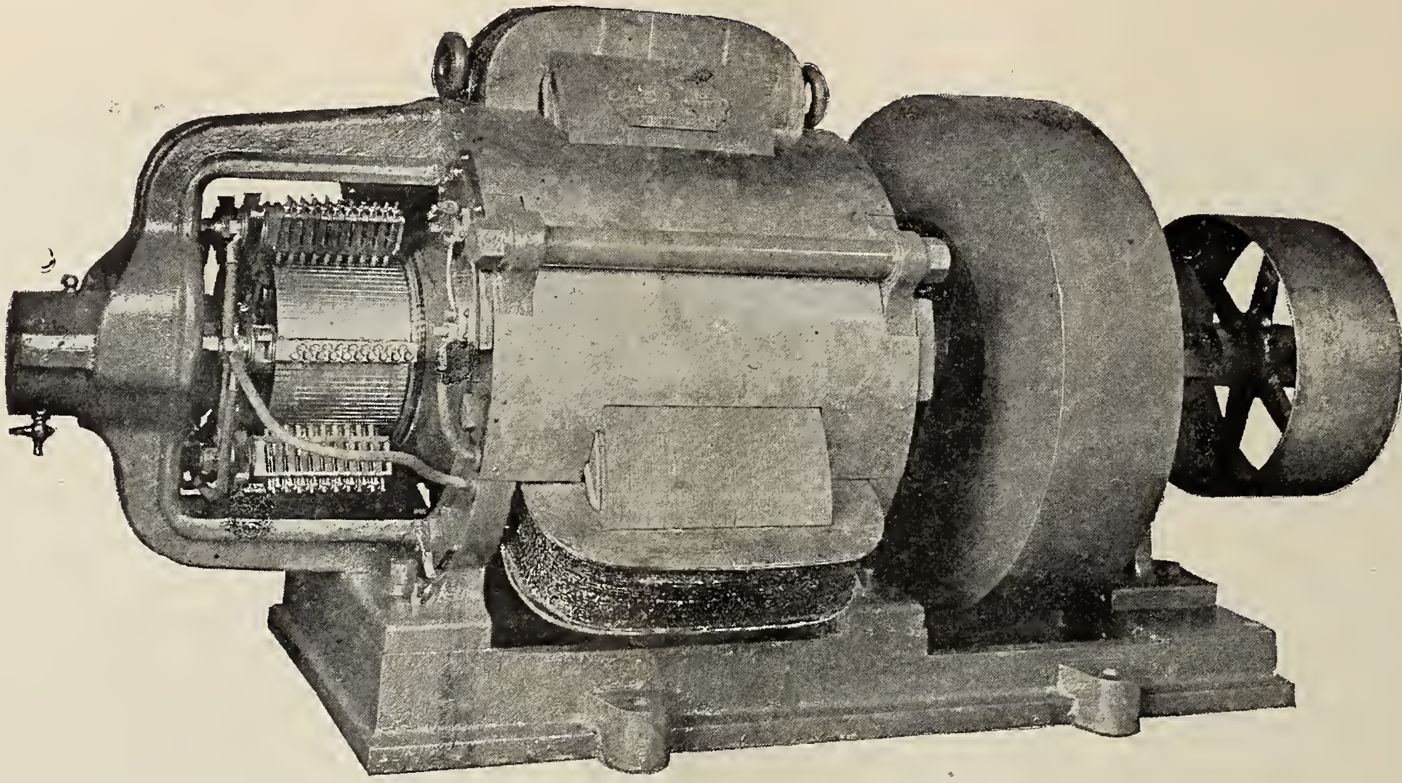
It is not difficult to attempt to transmit heavy power over long lines, as a precedent has been established which today may be looked upon as successful. The difficulty of using continuous current for long distance transmission is that of transformation.

Power can be economically sent from point to point as long as the pressure is high. The efficiency of a plant depends upon the voltage of the line to a greater extent than anything else. Continuous current dynamos use commutators which give rise to sparking troubles when high pressures are used. They cannot be safely connected in series, although the idea seems plausible, because the insulation is apt to give.

The economy of transmitting power is somewhat affected by the cost of the repairs. Weak machinery is as detrimental to a plant as poor insulation. There are no continuous current generators in existence that could safely be used for high tension work. Such pressures, for example, as 10,000 or 20,000 volts. Not requiring commutators, and being easily susceptible to transformation, the alternator is at present superior to all as a generating device.

In 1881 Deprez, of France, proposed that the current be generated at a low pressure, raised to a high potential, sent over the line and reduced to a low pressure again for commercial purposes. To accomplish this, continuous as well as alternating current transformers may be used. If the plant is a high-pressure continuous-current system, an increase or reduction in pressure is obtained by using a motor and dynamo in one. The armature is wound twice—once for a motor to receive the power, and again as a dynamo with sufficient turns and commutator to produce the pressure required.

The machine is called a motor dynamo or continuous-current transformer. The armature having two windings and two commutators is expensive and unsatisfactory for this purpose, except in special cases.



Machine Transforming Electrical into Mechanical Energy.

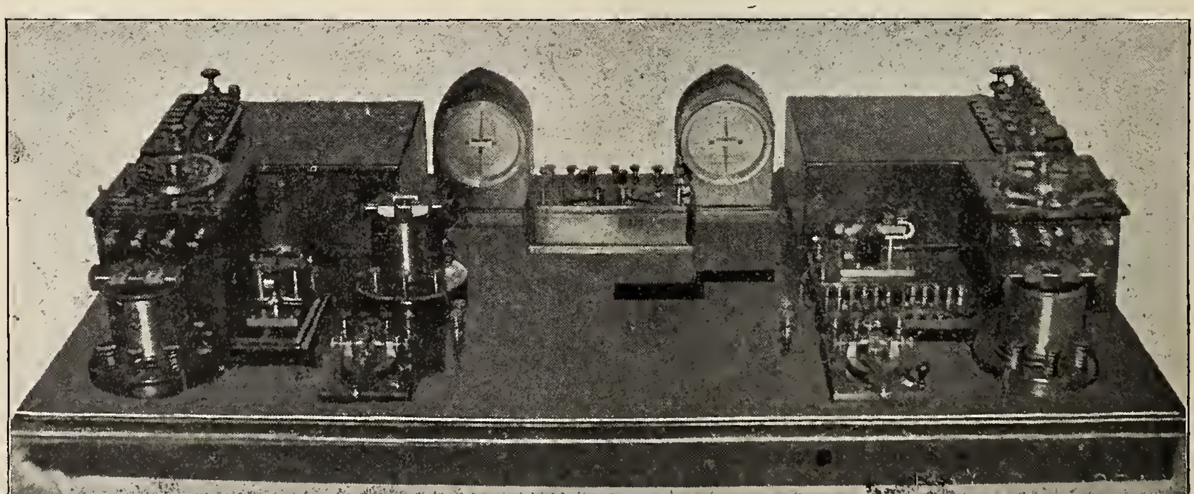
On the other hand a transformer, as previously described, is a simple magnetic circuit interlinked with coils. The absence of moving parts makes its use extremely practical. The difficulty of insulating it has been well overcome.

In transmitting power by alternating current the choice that exists lies between—

Single-phase,
Two-phase,
Three-phase systems.

In certain respects the two-phase has many advantages, but the matter is still in abeyance.

It may be said, however, that single-phase transmission plants are utterly out of the question. This now leads us to the examination of the reasons for choosing between the three.



Testing Outfit for Line.

Before the multiphase motor was invented, the single-phase current could not run a large alternating current motor unless it was first started by some other source of power and set into synchronism.

The introduction of two and three-phase currents, how-

ever, provided a means for overcoming this defect. Motors became self-starting when built on this principle and were introduced as a successful commercial feature of an alternating current plant.

This, then, in total, may be considered the reason why alternating current apparatus has become popular. The erection of a plant merely for the purpose of furnishing light is ridiculous, if conducted on a large scale. The transmission of power in one sense defines the object in view, and how is it possible to develop an enterprise so handicapped at the outset? Competition with continuous current plants, even though such installations cost twice as much, would eventually drive from the field those advocating another principle yet unable to meet all of its demands.

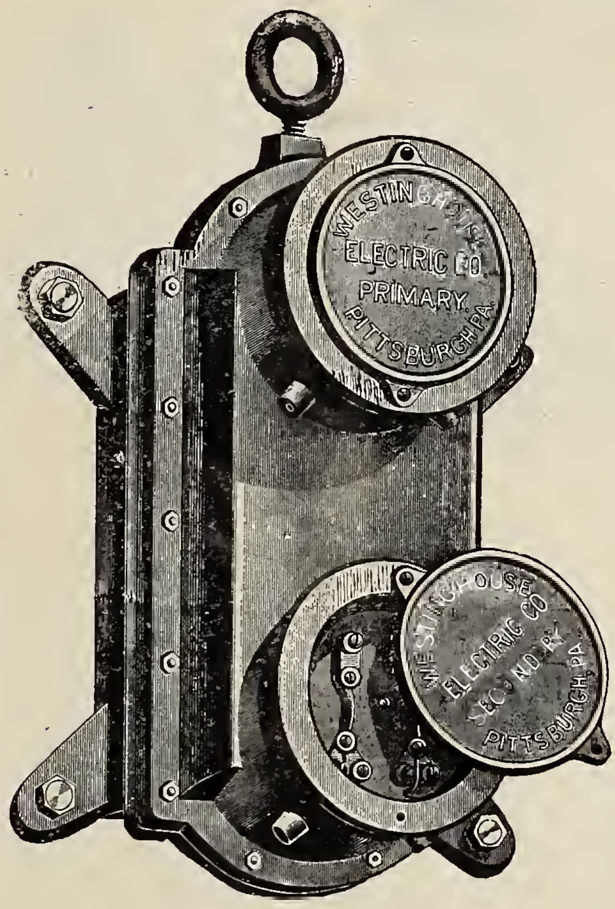
point a transformer is required. If 1,000 volts is received that is to be reduced to 100 volts, the following is true:

$$\frac{\text{Pressure required}}{\text{Pressure received}} = \frac{\text{turns on secondary}}{\text{turns on primary.}}$$

According to this the turns on secondary of this transformer will be $\frac{1}{10}$ of those on the primary.

$$\frac{100}{1000} = \frac{1}{10}$$

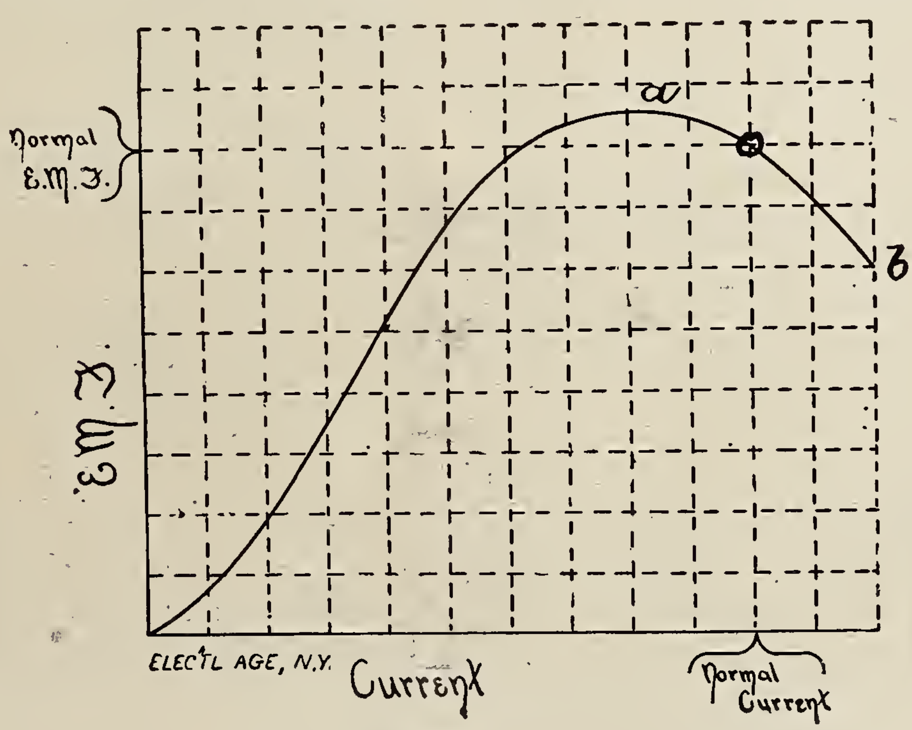
The weight of copper on each coil would be about alike in both primary and secondary.



Commercial Transformer.

The transmission of power is successfully carried on with a high pressure, an easy transformation, efficient motors and good line insulation. Attention to these factors means attention to the very elements of success.

The iron of a transformer is magnetized to about 45,000 lines of force per square inch. If forced to a higher pitch the iron will hum and heat. The primary coil must develop such a back electromotive force that, when the



Sine Wave.

DEPARTMENT OF ELECTRICAL ENGINEERING.

DESIGN OF TRANSFORMER.

To raise or lower the pressure received at a certain

secondary is not being used, very little current flows through it.

To calculate the volts in either coil, the lines of force passing through per second and the turns must be con-

sidered. The lines of force pass in and out many times a second; therefore the frequency must be taken into account.

The volts in the primary will be

$$\text{(Primary) volts} = \frac{\text{Lines of force} \times \text{frequency} \times \text{turns of primary}}{100{,}000{,}000.}$$

The volts in the secondary likewise:

$$\text{(Secondary) volts} = \frac{\text{Lines of force} \times \text{frequency} \times \text{turns of secondary}}{100{,}000{,}000.}$$

The primary acts automatically, allowing current to increase in its turns when demands are made upon the secondary. It also loses current when the secondary shuts off lamps, using less current. When the secondary is open, the primary is using the least possible current.

The magnetism in the iron is equal to the difference between that produced by the primary and the secondary. The currents flow in opposite directions in each coil; the resultant magnetization is therefore used.

—Commissioner S. S. Fisher has handed in a report to Congress. What he says is true. To arouse false hopes and cause an individual to invest in a worthless patent is fraudulent. It is a gold brick scheme, a phase of buncoism that has existed for years. Commissioner Fisher is right in warning the inventor. His language is direct and to the point: "The tendency of many agents to be more solicitous about the number than the quality of patents is aggravated by those who solicit patents on contingent fees, or who without special training and qualification adopt this business as incident to a claim agency, and press for patents as they do for back pay and pensions. Such men are often more desirous of obtaining a patent of any kind and by any means than they are of obtaining one which will be of any value to their clients. Inventors are often poor, uneducated, and lacking in legal knowledge. They desire a cheap solicitor and do not know how to choose a good one. They are pleased with the parchment and the seal and are not themselves able to judge of the scope and value of the grant. Honest and skilful solicitors, with a thorough knowledge of the practice of the office and of patent law, and who are able and willing to advise their clients as to the exact value of the patents which they can obtain for them, may be of much service to inventors. There are many such. But those who care for nothing but to give them something called a patent, that they may secure their fee, have in many instances proved a curse. To get rid of their client and of trouble they have sometimes been content to take less than he was entitled to, and in many cases they have, with much self-laudation, presented him with the shadow when the substance was beyond his reach. Between such men and the office strife is constant."

A New Illuminant.—The London correspondent of the Manchester "Courier" publishes a remarkable account of a new illuminant, which, if all that is said of it is true, will push both gas and electric light very hard. For its production no machinery is required save that contained in a portable lamp neither larger nor heavier than is used with colza oil or paraffine. This lamp, it is declared, generates its own gas. The substance employed is at present a secret, jealously guarded by some inventive Italians. The cost is declared to be at most one-fifth of that of ordinary gas, and the resultant light is nearly as bright as the electric light and much whiter. A single lamp floods a large room with light. The apparatus can be carried about as easily as a candlestick and seems both clean and odorless.

Prize for Electric Heaters.—The German Hygienic Association offers a prize of $1,200 for a research essay on the efficiency of electric heaters. The programme is as follows: "The heat given out in heating installations by heaters in their various forms and modes of use is to be ascertained. The investigations are to be described in detail in respect to the arrangement of the heaters, the nature of the heating agents, and the observations made;

ROENTGEN RAYS.

Spectrum of Sodium.—If a piece of lime is rendered incandescent by heating it in the oxyhydrogen flame, its light when transmitted through the spectroscope gives a perfectly continuous spectrum.—Prof. Peck.

Vapor of Iron.—Of the 600 bright lines which constitute the complex spectrum of the vapor of iron, more than 450 have been recognized as corresponding with the dark or reversed lines of the solar spectrum. More than one-third of the elements that we are acquainted with on our earth are known to exist in the sun. A few of the more common ones are iron, sodium, calcium, hydrogen, manganese, nickel, cobalt, barium, strontium lead and titanium.—Prof. Peck.

The Photosphere—Is the light-giving part of the sun. It surrounds the nucleus, and appears to be made up of enormous cloud-like masses, suspended, as it were, in a medium which is nearly or quite transparent. These shining masses, for want of a better name, are called clouds..... they are made up of metals and other substances maintained in a vaporous condition by intense heat.—Prof. Peck.

Faculae—Which are particularly numerous in the neighborhood of solar spots, are seen to the best advantage when near the border of the solar disk. They take the form of irregular luminous spots, and sometimes they are long and narrow, appearing like immense masses of photospheric matter heaped up in billowy ridges.—Prof. Peck.

Hysteresis—Physically speaking, the effect of the lag of magnetic induction behind magnetizing force when the iron is carried round a magnetic cycle is to make a dissipation of energy partly dependent on the maximum value of the induction and partly on the rate at which the cycle is performed.

Magnetic Time Lag.—Some physicists doubt the existence of a true magnetic time lag, and consider that whatever effects have been observed which experimentally point to such a lag of magnetization behind magnetizing force are the result of hysteresis and of eddy currents, and that the application of a magnetizing force whilst it is, say, increasing, produces in the iron reversely-directed surface eddy currents, introducing a reverse or opposed magnetizing force on the more deeply seated layers of iron, and that until these eddy currents subside the impressed magnetizing force is unable to produce its full effect in magnetization.

Rotation of Lines of Force.—That there is some kind of rotation going on along the lines of magnetic force has been held by Maxwell to be indicated by the behavior of a ray of polarized light when passing through a dielectric along a line of magnetic force, and he states that Faraday's discovery of the magnetic rotation of the plane of polarized light furnishes complete dynamical evidence that wherever magnetic force exists there is matter, small portions of which are rotating about axes parallel to the direction of that force.

The Citizens' Electric Light and Power Company.
Newark, Ohio, June 20, 1896.

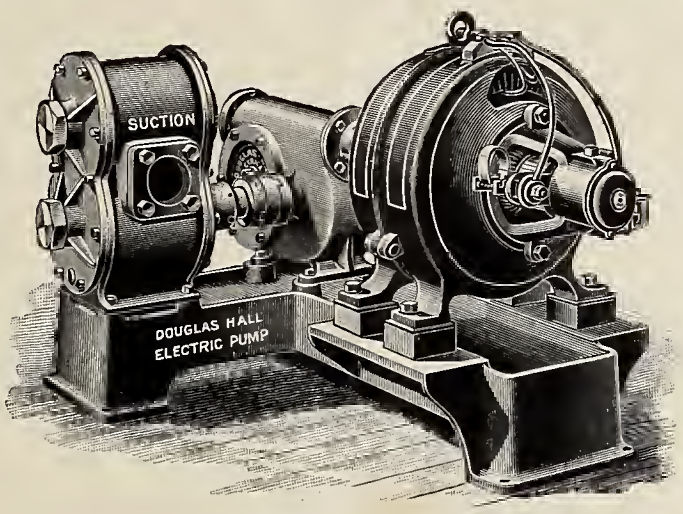
Automatic Circuit Breaker Co., Newaygo, Mich.

Gentlemen: The two improved circuit breakers have been received and placed in position and we assure you we are very much pleased with them. We think they are just the very best thing to have in our station and would not do without them if they cost two hundred dollars apiece. When we place our two additional circuits we will give you an order for two more. Have recommended our city plant to place them; they have five circuits. We assure you that we will do all the good we can. Yours truly, W. G. Taafel, Supt.

DOUGLASS-HALL ELECTRIC PUMP.

The electric pumping combination we illustrate has been designed particularly for maintaining a supply of water for house purposes, operating hydraulic elevators or for any service where it is desired to elevate or distribute water. The manufacturers were among the first to adapt the pump to the electric motor, and the present combination represents the result of an extended experience in this line of work.

Any form of electric motor can be used with the pump, that shown in the illustration being of the Lundell type.



Douglass-Hall Electric Pump.

To the shaft of the motor armature is direct-coupled a two-part worm, one helix being right and the other left-handed; these mesh with two gears, to one of which the pump shaft makes fast. By means of this double worm-gearing, end thrust of the worm is entirely obviated. The pump is of the rotary gear type, the action being similar in principle to that of the well-known Root blower. There are two wide gears, each having twelve deep teeth, the driving gear being of brass and the other one of hard rubber. This, it may be remarked, is one of the oldest types of water pumps, its invention dating from the 16th century. In its original form a serious objection was encountered from friction and constant wear, due to the reaction of the discharge pressure. In the present type this pressure is balanced by means of ports or radial openings between each tooth and extending through the gears, the discharge pressure being thus made to act on both sides of the gears, thereby perfectly balancing them. Owing to this ingenious method, the gears are subject to no grinding wear against the suction side of the gear case, and the bearings will run true indefinitely.

The pumping out includes an automatic rheostat operated by an electrical device at the receiving water tank. The pump described is the invention of Mr. M. W. Hall, and is manufactured by the W. & B. Douglass Co., No. 87 John street, New York.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)-THERMO BATTERY ELECTRIC LIGHTING.

San Francisco, Sept. 12, 1896.

Dear Editor:—Kindly excuse the liberty I take in asking whether a thermo battery can be constructed that will light a home. I think the use of coal in a stove that produced electricity direct would be cleaner and better than our present method. Yours respectfully,

Geo. A. Hunter.

(A.)—Thermo batteries were constructed for this purpose long ago. Clamond built a thermo battery that was used for electroplating. The elements were antimony and zinc; coal gas was used for heating the junctions. A battery of 60 elements gave three volts and about two amperes. It used three cubic feet of gas an hour. Coal could be used directly with corresponding cheapness if the battery were properly made. Mr. Cox, of England, has invented one combining features similar to the above. There may be a future in plants of this kind in the summer, to provide power for electric lights and fans at home.

(Q.)—USE OF CONDENSERS.

Yonkers, Sept. 6, 1896.

To the Editor:—Can any rule be given by which a condenser may be connected in circuit with a motor? The self-induction of the motor is so great that it turns slowly. I thought the Stanley Co. used condensers in circuit with their motors and wanted to try it myself on mine. Kindly give whatever information is handy for me.

Yours truly,

Albert Shulz.

(A.)—Condensers are connected either in series or multiple. Connect yours in multiple with the motor. You have not mentioned its size or anything in connection with it. Take some waxed sheets with tinfoil on one side and build up a condenser. You can add sheets until your motor runs at its best. The rule is not difficult, but you will have to know the self-induction of your motor.

Calling Self-induction = L.
Resistance = R.
Frequency = P.
Capacity = C.

The condenser, if in multiple, must have a capacity of

$$C = \frac{L}{R^2 + P^2 L^2}$$

(Q.)—A MAN'S POWER.

New Orleans, Sept. 5, 1896.

Electrical Age Pub. Co.

Dear Sir:—Having had frequent occasion to use your interesting Inquiry Column in satisfying myself about certain things, I am anxious to know how much power a man can exert, reckoned in horse-power, on the basis of the English unit, 33,000 foot pounds?

Yours very truly,

Francis de Long.

(A.)—Without consulting any data our opinion leads us to believe that for continuous work a man's strength is equal to one-eighth or one-quarter of a horse-power. During sudden and violent efforts the rate at which he exerts power may exceed one horse-power. In certain cases it may reach two horse-power and over. Mr. Sandow could probably exert a tremendous amount of strength for a few moments, far exceeding these figures, but such efforts would be those of one blessed with an abnormal physique and consequently not included in the average.

Burlington, Vt.—The Porter Screen Manufacturing Company will at once erect a factory 200 by 40 feet in size, and a storehouse 140 by 40, both two stories in height.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 540.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

THE GERMAN STANDARD CANDLE (VEREINSKERZE).

VII.—A. VERNON HARCOURT'S PENTANE STANDARD.

This standard* consists of a gas flame produced in burning a mixture of 20 volumes air with 7 volumes of pentane vapor. The flame is $2\frac{5}{1}$ in. height, the orifice through which the gas passes being ¼" in diameter. The rate of consumption of the gas is ½ cu. ft. per hour. The standard temperature for making the mixture is 60° F., and the standard pressure is 30 in. of mercury. The pentane used is the most volatile portion of American petroleum, and is obtained by repeated distillation of gasoline, which has been purified by treating with sulphuric acid, and afterwards with a solution of sodium hydroxide. The distillation is carried on until the whole passes over at 120° F. The product is nearly pure pentane, C_5H_{12}. It is mixed, however, with a small portion of hexane, which it is claimed, will not affect the illuminating power of the gas, since it is so similar in chemical composition to pentane. The pentane evaporates more quickly than ether, and is nearly insoluble in water. Its specific gravity at 60° F. is between 0.628 and 0.631; its vapor is 2.5 times as heavy as air. The flame produced is said to be steady when the gas is rich and the flame not too large, while an additional advantage consists in the fact that the rate of consumption of gas at a given flame height furnishes a check upon the purity of the gas.

Dibdin, in his tests made in 1885, used an apparatus set up by Harcourt himself. He found that when the air gas was made over fresh water in the gas holder, his results did not agree exactly with those obtained when the water had been previously used for the same purpose. The size of the holder, and the exact purity of the gas seemed to have no effect upon the candle-power given. From his measurements, the maximum fluctuations were found to be 1.9 per cent., while 90 per cent. of the measurements lay within 1 per cent. of the mean. Five different operators, using the same burner, made measurements which were not so concordant. Their maximum deviation was 3.5 per cent., while only 44 per cent. fell within 1 per cent. of the mean. Dibdin found the steadiness of the flame to be affected but little by disturbances in the room, etc. This is quite opposed to the results of Heisch and Hartley, who had found that small disturbances in the neighborhood caused very considerable and very troublesome fluctuations in the size of the flame."

Dibdin's report of 1888 shows the maximum variation to have been over 5 per cent., and 80 per cent. within 1 per cent. of the mean. He says: "The facts brought out by the inquiry have shown that the method of preparing the air-gas is at once easy and safe; that the measurement of the volume of gas used is simple and reliable; that the adjustment of the flame height is a matter of certainty; its steadiness all that could be desired when due care is taken and proper apparatus employed; and that the quality of the light afforded is precisely the same as that of the standard comparison flame."

The committee of the British Association, in 1888, reported that the pentane standard was reliable and convenient, and fulfilled all the conditions required of a standard of light. They found that the light was not altered by using pentane of specific gravity of 0.628 or 0.632 instead of the normal specific gravity 0.630. Out of 117 tests which they made, only one showed a variation of one per cent., and there were no larger variations than that.

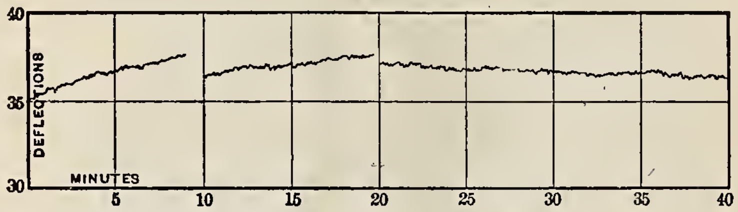


FIG. 13.—Harcourt Pentane Lamp.

VIII.—THE PENTANE LAMP.
(Woodhouse and Rawson Pattern.)

In the pentane lamp we have a flame of pentane vapor set free from a wick, and burning inside a metal chimney cut away in the middle. The height of the flame is adjusted by noticing when the point of it plays inside the limits of a vertical slit in the upper part of the chimney. The distance between the upper and lower parts of the chimney determines the intensity of the light. It can be adjusted to give one candle or one and a half candles.

Dibdin, in his report in 1888, states it to be remarkably steady. The maximum fluctuation which he found was 2.5 per cent., while 97 per cent. of the tests fell within 1 per cent. of the mean.

The committee of the British Association in 1888 reported that out of 118 tests but two showed fluctuations of 1 per cent., which was a maximum.

Rawson† compared the pentane lamp with the glow lamp on a photometer bar. He found for the pentane lamp absolute steadiness for periods of from 15 to 75 minutes. Variations were due to two causes:

(1) The changes of temperature in the air of the room, which can be minimized by immersing the lamp-font up to the stopper in water.

(2) The escape of pentane vapor through the stopper. This may be prevented by placing a drop of glycerine on the stopper.

Mr. C. H. Clifford of the Massachusetts Institute of Technology‡ compared two pentane lamps with each other and found a maximum deviation of 1.57 per cent., while five out of 18 observations varied by more than 1 per cent. from the mean. He says: "The Harcourt pentane lamp as a legal standard would seem to be a satisfactory one as far as mere intensity and constancy of illumination are concerned, although the uncertain quality of pentane and the care required in using the lamp are undoubtedly objectionable."

But a single reliable curve, Fig. 13, has been obtained by the bolometer for this standard. The great steadiness of the flame due to the chimney employed is manifest at once. This form of chimney evidently is quite as efficient in this respect as is the Carcel lamp chimney, and it is not subject to the disadvantages of the latter form.

* A. Vernon Harcourt, Report of the proceedings of the British Association, 1877. Chemical News, 36, 103. Electrician, 11, 188.

† Elec. World, London, vol. xii, p. 251.

‡ Tech. Quarterly, 1890.

(Continued on page 556.)

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CONTENTS.

	PAGE
EDITORIALS	
The Deficient Fire Alarm System	555
What is Electricity	555
GENERAL SUBJECTS	
The Transmission of Power	549
Department of Electrical Engineering	551
Standards of Light	554
EXTRACTS	
Roentgen Rays	552
TRADE NOTES	
Douglass Hall Electric Pump	553
Clonbrook Steam Boiler Co.	557
Interior Conduit & Insulation Co.	560
Possible Contracts	563
NEW CORPORATIONS	563
PATENTS	564
INQUIRY COLUMN	553

THE DEFICIENT FIRE ALARM SYSTEM.

The present investigation of the condition of the fire alarm system of this city has revealed the fact that a condition of almost total ignorance prevails among those whose business and duty it is to report on its efficacy. It has shown that the apparatus used is old and necessarily deficient, or that the electrical conditions at present existing are such that the percentage of signals received out of a hundred is remarkable, considering the defects of the system.

We have but little to say about the appalling danger of delay during a fire—the loss of property and life that may accrue. But we have everything to say in denunciation of those that peristently refused to consider those necessary innovations which have been so universally adopted by cities poorer than our own, yet whose first thought was for the life and property of its inhabitants.

"WHAT IS ELECTRICITY?"

There is a charm in investigation that is the stimulus of thought itself. The mystery of a current, its silent flow and remarkable peculiarities always have been and will be the subject of legitimate wonder. The unreality of the real charms us with its frightfully apparent truth. There is in substance itself the shadow of doubt—in all the complex and varied phenomena of nature an overhanging mystery. Analysis has frequently been brought to bear upon the phases of that phenomenon called electricity. It is the severest mental discipline the mind can go through. From the legend of the Soul of Amber to the latter-day prosaic deductions, the truth has been sought.

The question blankly confronts us, "What is electricity?" Armed as we are with methods and means that unravel the secrets of the most profound mysteries, some success, characterized by a palpable reality should reward our efforts. Faraday and Maxwell have disclosed the scene and base of that which in the aggregate has been called electricity—its undulating waves of force, the features of similarity between all its allied phenomena. When Rowland rotated a charged disk and obtained a magnetic deflection, the static charge and electric current ceased to express radical differences. When the magnetic wave, piercing space at the rate of 186,000 miles a second, was found to travel no faster than an electric impulse, a relationship hitherto unknown was strikingly exhibited.

There is therefore in this allied relationship a fertile field of facts. Ethereal stress and strain is the physicist's explanation. Maxwell evolved the idea of an electric particle, which by its juxtaposition with the material molecules gives issue to electrical phenomena.

A mechanical theory of electricity has been illustrated by Fleming on the basis of Maxwell's work, and a mass of literature swells the archives of German and English libraries on this subject. Let us be assured of one thing at least. The phenomena of a current or a charge owes its existence to the presence of ether, much the same as light, magnetism or even chemical attraction. The ether is probably greatly modified when in actual contact with matter. A closer study of the nature of electricity would be therefore much more fruitful if the properties and nature of the ether were carefully examined. This is the new science in which resides the truth concerning less striking phenomena—cohesion, chemical affinity with all its diversifications and the problem of nebulous formations. What we know of electricity today is limited to the statement that it is some form of systematic molecular action which is either brought about by ether in a state of strain, or merely represents the cause from which such influences incidentally extend. This form of investigation is essentially that of a "process." Our minds may be benumbed by its marvellous complexity or supremely elevated by its hidden simplicity. The fruits that have been garnered are piling up. There will soon be a time when the question "What is Electricity?" will be ignored by one of greater importance, "What is Ether?"

—The unsubstantial nature of many electrical enterprises has led capitalists to become acute critics instead of mere moneyed men. Electrical engineering has become of late a symbol of American progress. The capitalist need fear no longer. The profession is now upon a cash basis. Our new bills testify to this: "The new $2 and $5 silver certificates have been printed and are ready for issue. Like the $1 certificates, they are a striking departure in money making. Black ink is used in printing the front of the notes, while the back is of the conventional green. The $2 note was designed by Edwin H. Blashfield, of New York, and the face contains an allegorical representation of 'Science Presenting Steam and Electricity to Commerce and Manufacture,' and consists of five partly nude female figures in graceful poses. Walter Shirlaw, of New York, designed the $5 note. The face has an allegorical picture representing 'America Enlightening the World,' a beautiful female, partly nude, holding in her right hand, uplifted, a lighted incandescent lamp. Reclining at her feet is a female figure of Fame with the traditional trumpet. The notes are beautiful specimens of the engraver's handicraft, and in that respect will compare favorably with any work in that line."

At Klausthal, Germany, a bolt of lightning instantly melted two wire nails 5.32-inch in diameter. To melt iron in this short time would be impossible in the largest furnace now in existence, and it could only be accomplished with the aid of electricity, but a current 200 amperes and a potential of 20,000 volts would be necessary. This electric force for one second represents 5,000 horsepower, but as the lightning accomplished the melting in considerable less time, say 1-10th of a second, it follows that the bolt was 50,000 horse-power.—Southern Architect.

(Continued from page 554.)

The lamp was adjusted to give 1 c.-p. and had been burning 1½ hours before the curve was begun. During the first nine minutes of the curve the height of the flame changed, remaining, however, always within the limits of the vertical slit. The intensity changed during these nine minutes by 6.7 per cent. of itself. The flame was then readjusted. During the next nine and a half minutes a similar change took place, the total variation being 2.9 per cent. After a second readjustment the flame settled down to a fairly stable condition. The flame height was a trifle low at the end of the curve, at which time the intensity had fallen to a minimum value of 1.4 per cent. below the mean. At the end of the second ten minutes the intensity was 1.4 per cent. above the mean. Omitting the values at the beginning of the curve, which may perhaps not be quite so reliable as the rest, the total variation is seen to be 2.8 per cent. The changes produced in the two readjustments were 3.2 per cent. and 1.4 per cent. rescectively. Of course, from this single curve nothing can be said concerning the reproductibility of the standard. The bolometer shows the intensity of this lamp to be less than 1 c.-p., and photometric measurements have confirmed this result.

Weighty objections to this lamp as a standard are the unstability of the flame under certain conditions, and the lack of a well-defined mark at which the flame height can be adjusted. It is to these faults that the variations during the first twenty minutes of the curve are due.

Liebenthal* investigated the relation between the height of the flame and intensity of the light, finding the following values: For the flame point at the bottom of the slit the intensity was 97.9; for the flame point one-third o: the way up the slit, 99.5; one-half of the way, 100; two-thirds of the way, 99.5; at the top, 97.5.

Accordingly he adjusted it at the middle of the slit, taking that flame height as corresponding to normal intensity. He says: "Still greater variations of flame height produce changes which are not negligible, even for technical purposes. The intensity is about eight per cent. less than normal when the point of the flame projects by a small amount (about seven mm.) over the top of the slit, and a further decrease of at least seven per cent. is found when the flame becomes still larger. More than this, on account of the heating of the parts of the lamp, until a certain thermal equilibrium is reached, which is about 30 minutes after lighting, two things occur:

(1) The flame increases continually, so that the wick must be steadily lowered.

(2) The intensity increases and finally goes over into a constant value, which is several per cent. larger than the original value. Only when such a stationary condition has been reached, and the flame height changes but gradually, can one leave the lamp unwatched for a little while without fearing that it may become overheated."

By making many photometric measurements, extending over a long time, using a glow-lamp as a secondary standard, and by determining each day the hygrometric state of the air, by means of an Assmann's hygrometer, Liebenthal investigated the effect upon the intensity of the light which the moisture in the air exerted. From 75 observations of this sort the intensity of the Harcourt lamp in terms of the Hefner light as unit can be expressed by the following equation:

$$y = 1.232 - 0.0068\ x.$$

or

$$y = 1.232\ (1 - 0.0055\ x),$$

where y represents the intensity, x the watery vapor in liters to each cubic metre of dry air, free from carbon dioxide. This formula holds good between the limits of observation which were from 4 to 18 liters, and gives us a variation of about 0.6 per cent. per liter of moisture. The mean deviation of observed intensities from those computed from the equation was found to be 0.81 per cent., and the maximum deviation was 1.6 per cent.

By making observations under varying pressure in a physician's pneumatic cabinet, the following relation between intensity and barometric height was obtained.

$$\Delta\ y = 0.00049\ (b - 760),$$

where b represents the barometric height in millimeters.

Hence, to a change in barometric height of 40 mm. corresponds a change in intensity of two per cent.

The Dutch Light Standard Commission found the Woodhouse and Rawson pattern of the Harcourt lamp to be the most promising form of light standard. They objected to the use of pentane as not being of definite chemical composition, and a modified form of lamp was arranged to burn a mixture of 100 parts of ethyl ether and nine parts benzole. Their lamp reproduces all of the essential features of the Harcourt lamp. One important modification is that they make the chimney and upper portion of the wick tube detachable.

This can be placed on a base by which illuminating gas can be admitted, lighted and burned until all these parts of the lamp have reached a stationary temperature. The chimney and wick tube are then replaced upon the font, and, upon lighting, the lamp is ready to be used in photometric measurements.

The materials which are burned in the lamp can readily be obtained in a pure state, and are not excessively expensive.

They found that for slight changes in the amount of benzole added, when the proportions recommended were approximated to, the intensity of the lamp varied very slowly. Two series of ten settings each of two of these lamps against each other showed a variation of +0.52 per cent., while their intensities were equal. The maximum variation was ±2.10 per cent.

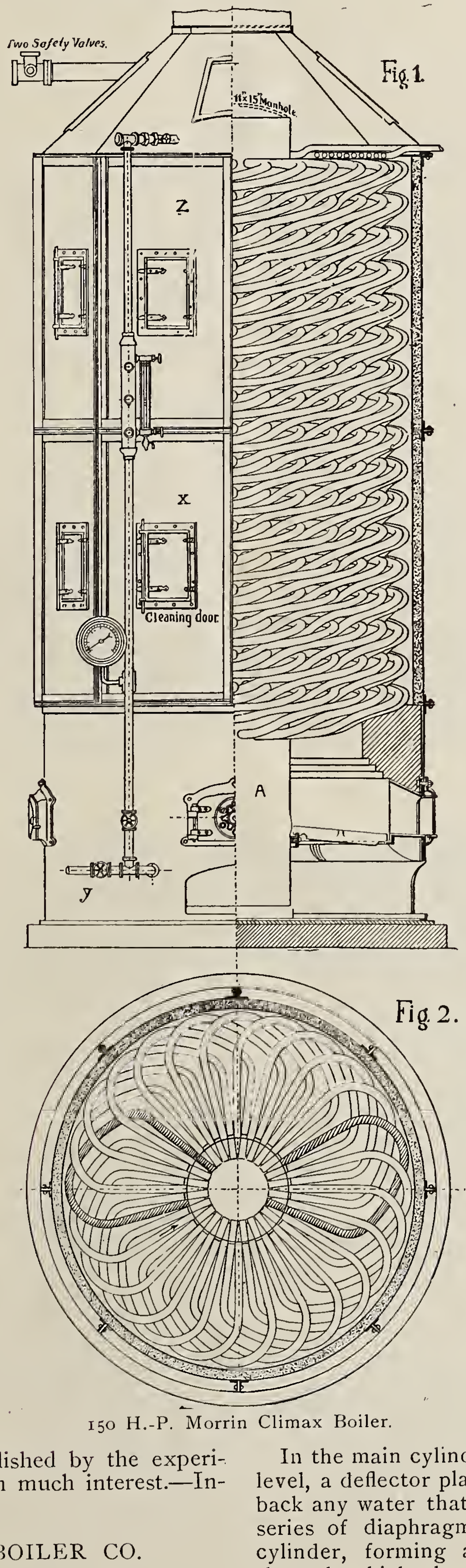
(To be continued.)

* Liebenthal, Elektrotechnische Zeitschrift, vol. xvi., p. 655.

Across the Ocean on Wheels.—One of the most curious specimens of naval architecture ever placed on the water is the so-called "roller" steamer launched last week at the Cail shipyards, at St. Denis, near Paris. This vessel is built on a novel principle invented by M. Bazin, a well-known French marine engineer, who has embraced the theory that vessels can more easily roll over the water than cut through it. The boat just launched, and which is to be used for experimental purposes in the English Channel, is described as "a large rectangular iron box, about 120 feet in length, 40 feet wide and 5 feet high. It is mounted on six lenticular disks, or rollers of sheet iron, shaped like double converse lenses, 30 feet in diameter. In the sides of the box is the machinery, which is 750 horse-power. The propelling power is a screw hanging in brackets from axles of the rear rollers and submerged much as ordinary steamer screws. In the upper part of the vessel, between the disks, which pierce the box and extend beyond it about 6½ feet, are cabins fitted up with the accustomed sea-going comforts. M. Bazin's vessel has a displacement of 280 tons. This displacement is made and the burden borne by the disks, which are sunk in the water about 10½ feet, which brings the bottom of the iron box about the same distance from the surface of the water."

It is claimed, as the results of tests made with a model, that the power necessary to keep the rollers at work is only one-fourth of the power that is required to keep the screw going, while by an extra expenditure of power, amounting to another fourth, the speed of the vessel is doubled. Thus, the inventor points out, with the use of rollers, the length of voyage may be greatly diminished, while the consumption of coal will be lessened, resulting in a great saving of time and cost. Moreover, it is asserted that the stability of the rolling boats will be far greater than that of the steam vessels now used. When ready for sea, the Bazin steamer will descend the Seine to the English Channel and cross to London. The inventor

expects her to make at least thirty miles an hour in the Channel. M. Bazin, it is reported, has prepared designs for a large ocean going steamer on the roller principle, which he estimates will make the voyage from Havre to New York in four days. The innovation is a bold one, and the results accomplished by the experimental vessel will be watched with much interest.—Inventive Age.



150 H.-P. Morrin Climax Boiler.

CLONBROCK STEAM BOILER CO.

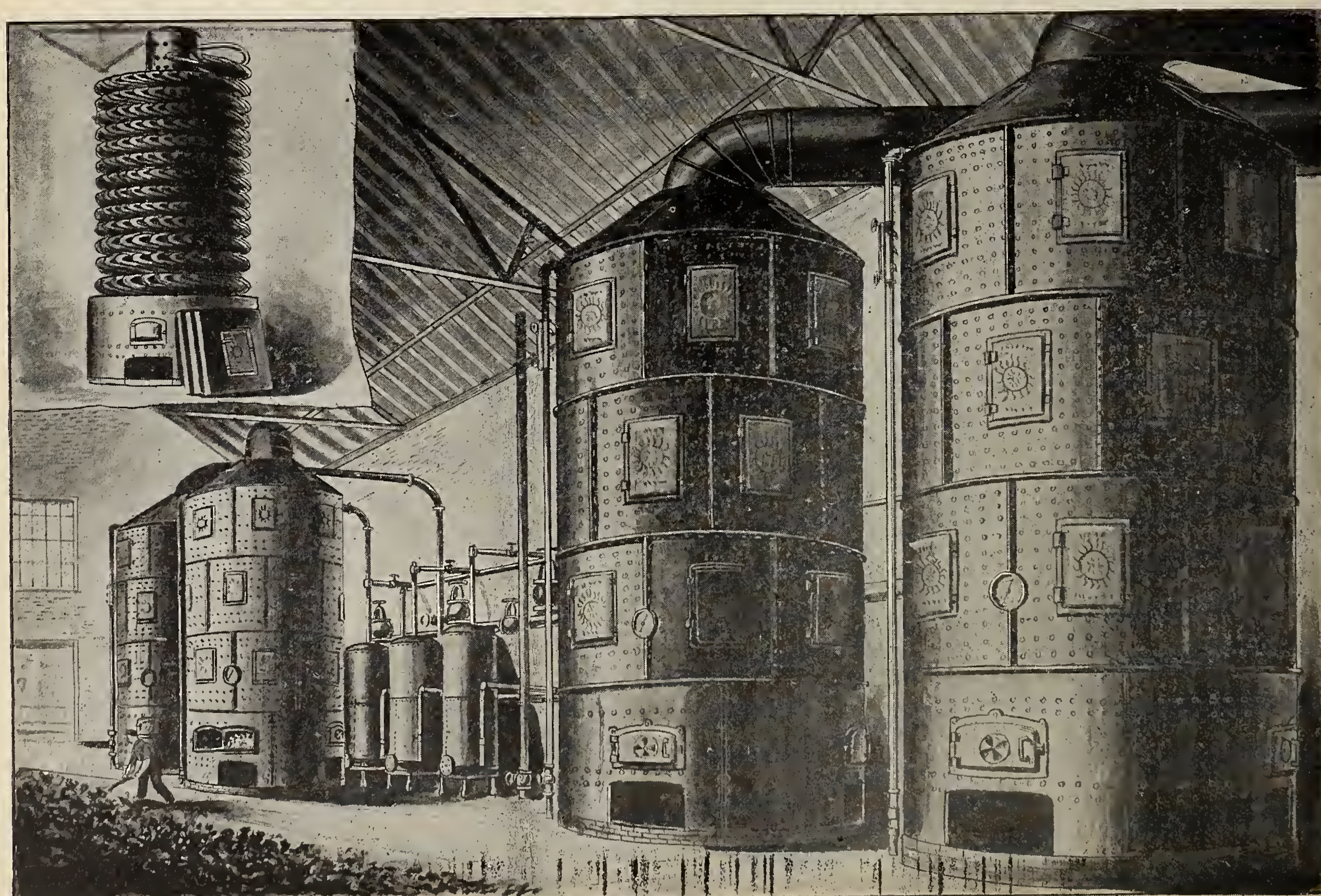
The boiler that has excited considerable attention of late on account of the excellence of its construction as well as its rapid and efficient steam generating properties, is manufactured by the Clonbrock Boiler Co.

The boiler consists of a vertical shell and loop-shaped tubes extending the entire height of the generator.

The heating surface is therefore very large and well distributed for the generation of steam and circulation of water.

In the main cylinder, a short distance above the water level, a deflector plate is inserted, which tends to throw back any water that may be carried by the steam, and a series of diaphragms divide the upper portion of the cylinder, forming a series of superheating chambers through which the steam is successively compelled to circulate by the connecting loop-like tubes, thus becoming thoroughly dried and superheated. The upper portion of the boiler contains a reservoir in which the steam is likewise treated.

Works of the Clonbrock Steam Boiler Co.

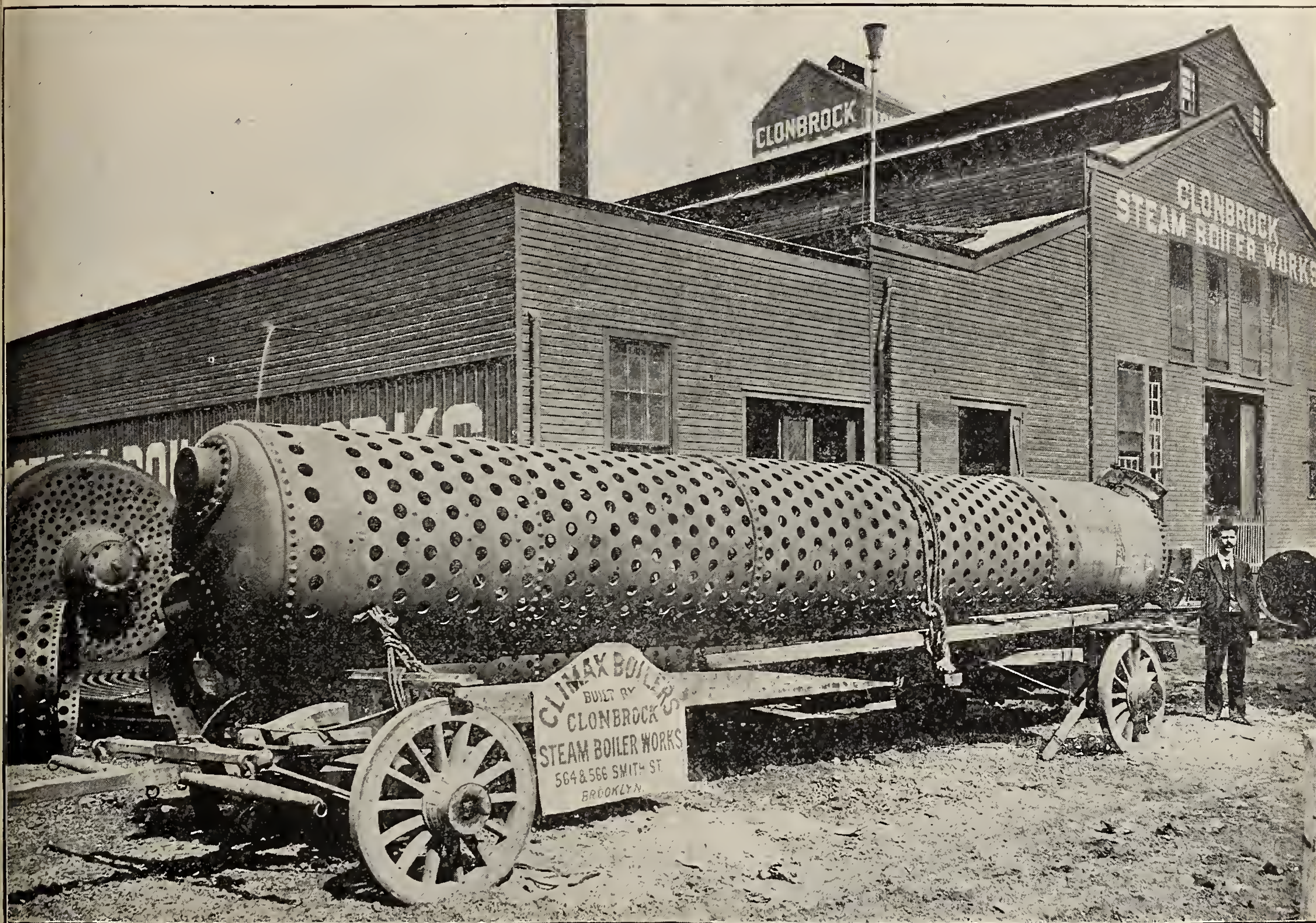


Boiler Room of the Brooklyn City and Newtown Railroad Co., Brooklyn, N. Y., containing Six 350 H. P. Morrin "Climax" Boilers.

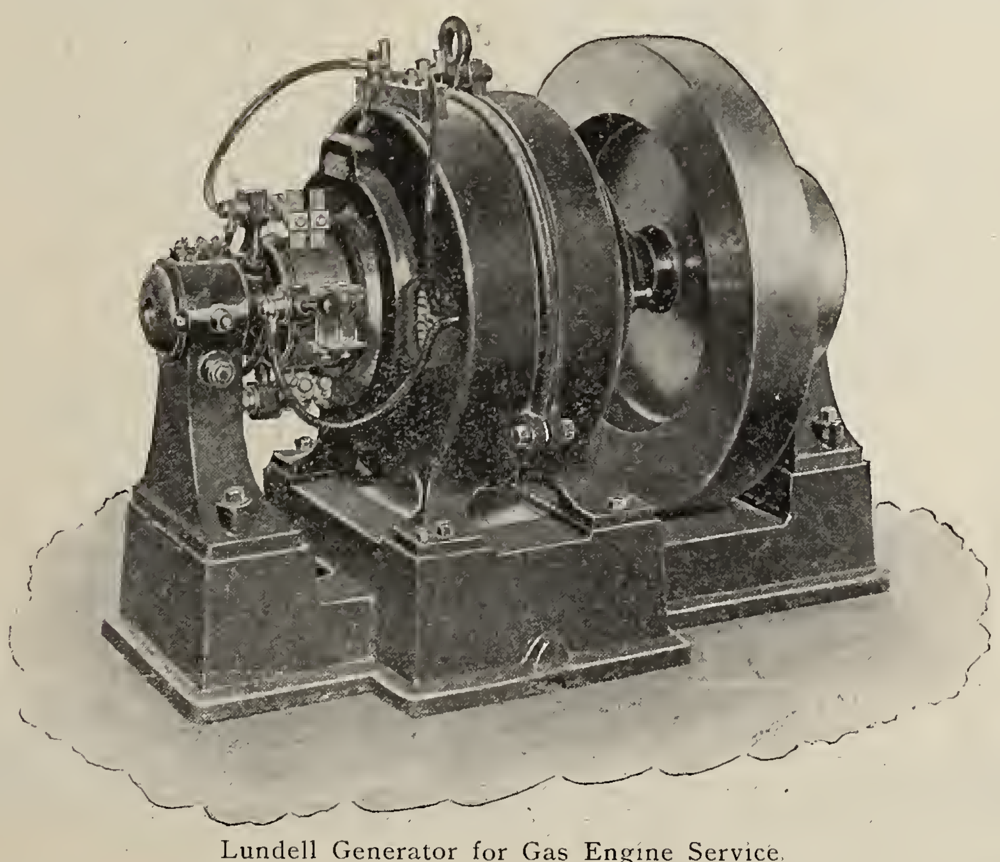
Above the central shell is a coil of tubes several hundreds of feet in length, in which the feed water flows before entering the boiler.

The following notes on this department of the subject may be of interest to some of our readers:

—The Clonbrock Steam Boiler Company, of Brooklyn, report a large rush of business, their order sheets being so full that it is necessary to have on a night force to complete orders already booked for January 1, 1897. Among their latest orders are the American Manufacturing Company, Brooklyn, 500 horse-power; Hazelton Light Company, Hazelton Pa., 800 horse-power; People's Light

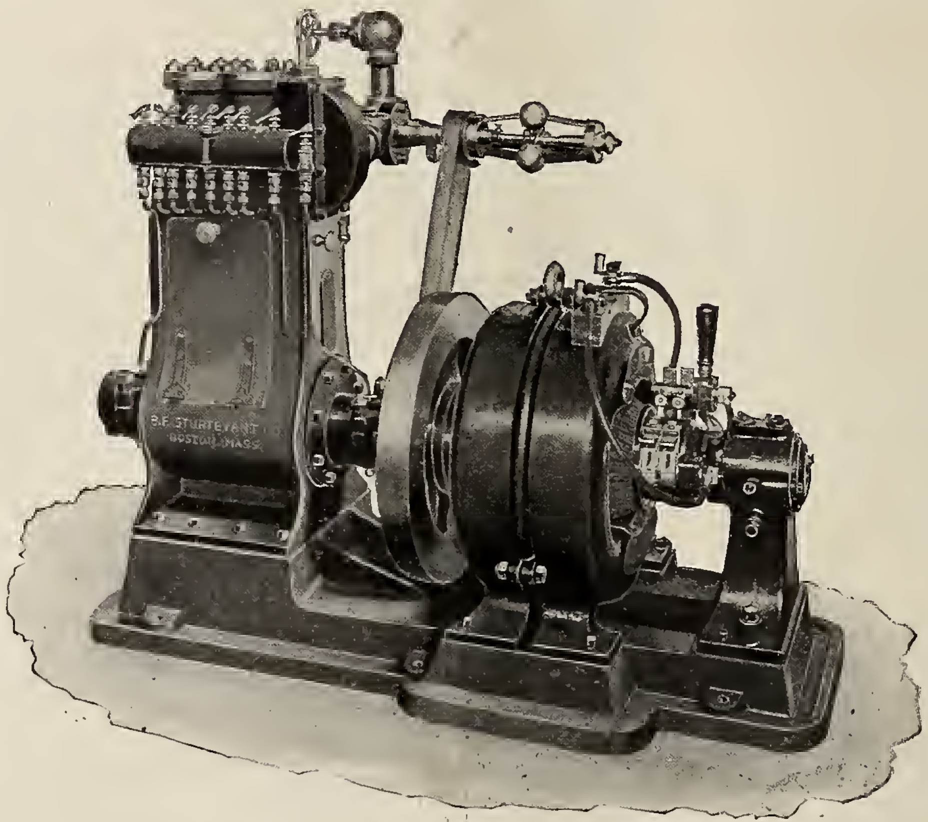


600 H.-P. Morrin "Climax" Boiler Shell, Loaded on Truck and Ready For Shipment. Built for People's Electric Light Co., East Orange, N. J.

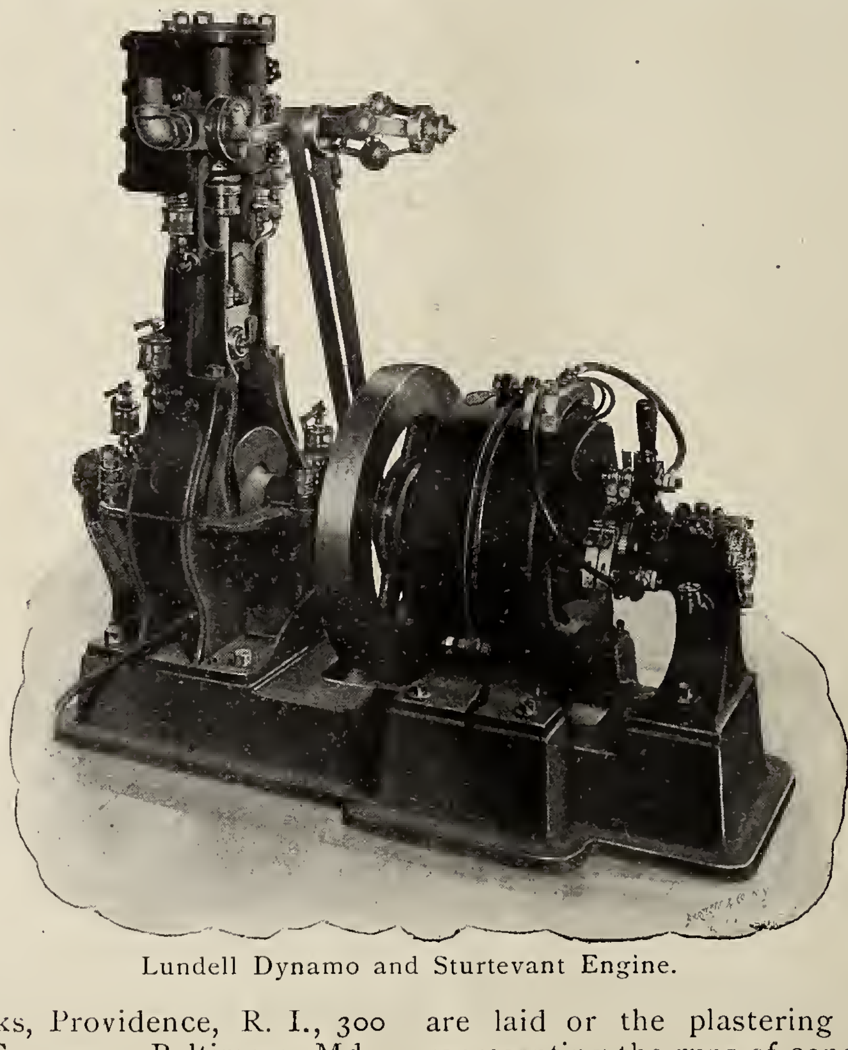


Lundell Generator for Gas Engine Service.

& Power Co., Jersey City, N. J., 1800 horse-power; Municipal Electric Light Company, Brooklyn, N. Y., 2,000 horse-power and one steel self-supporting smoke-stack, 16-inch diameter and 175 feet high; Economy Light, Heat and Power Company, Scranton, Pa., 1,000 horse-power; Johnson Coal Company, Priceburg, Pa., 400 horse-power; Marshall Paper Company, Turners Falls, Mass., 150 horse-power; People's Light & Power Co., Orange, N. J., 2,400 horse-power; Geo. Watkinson Rubber Works, Philadelphia, Pa., 250 horse-power; Esperanza Plantation, Bayou Lapourche, La., 600 horse-power; Mathieson Alkali Works, Providence, R. I., 300 horse-power; Brush Electric Company, Baltimore, Md., 1,000 horse-power; New York Steam Company, New Station, N. Y. City, 3,000 horse-power; Brush Electric Company, Baltimore, Md., 1,000 horse-power; Coney Island & Brooklyn R. R. Company, Brooklyn, N. Y., 700 horse-power.



Lundell Dynamo and Sturtevant Engine.



Lundell Dynamo and Sturtevant Engine.

INTERIOR CONDUIT AND INSULATION COMPANY.

To explain more fully the method of installing the iron-armored conduit in a fire-proof building, we herewith illustrate a section of a modern fire-proof building of moderate dimensions, recently installed for the three-wire street service.

The illustration shows the brick walls and terra-cotta partitions of building, the conduit being installed on top of ceiling arches and on partition walls, before the floors are laid or the plastering is applied. The full lines, representing the runs of conduit, are those in sight from the perspective shown; the dotted lines indicate the runs on partitions and floors that would not be seen from this view of the building.

It is generally required in office buildings, hotels, etc., that the lights in halls, vestibules and other places be

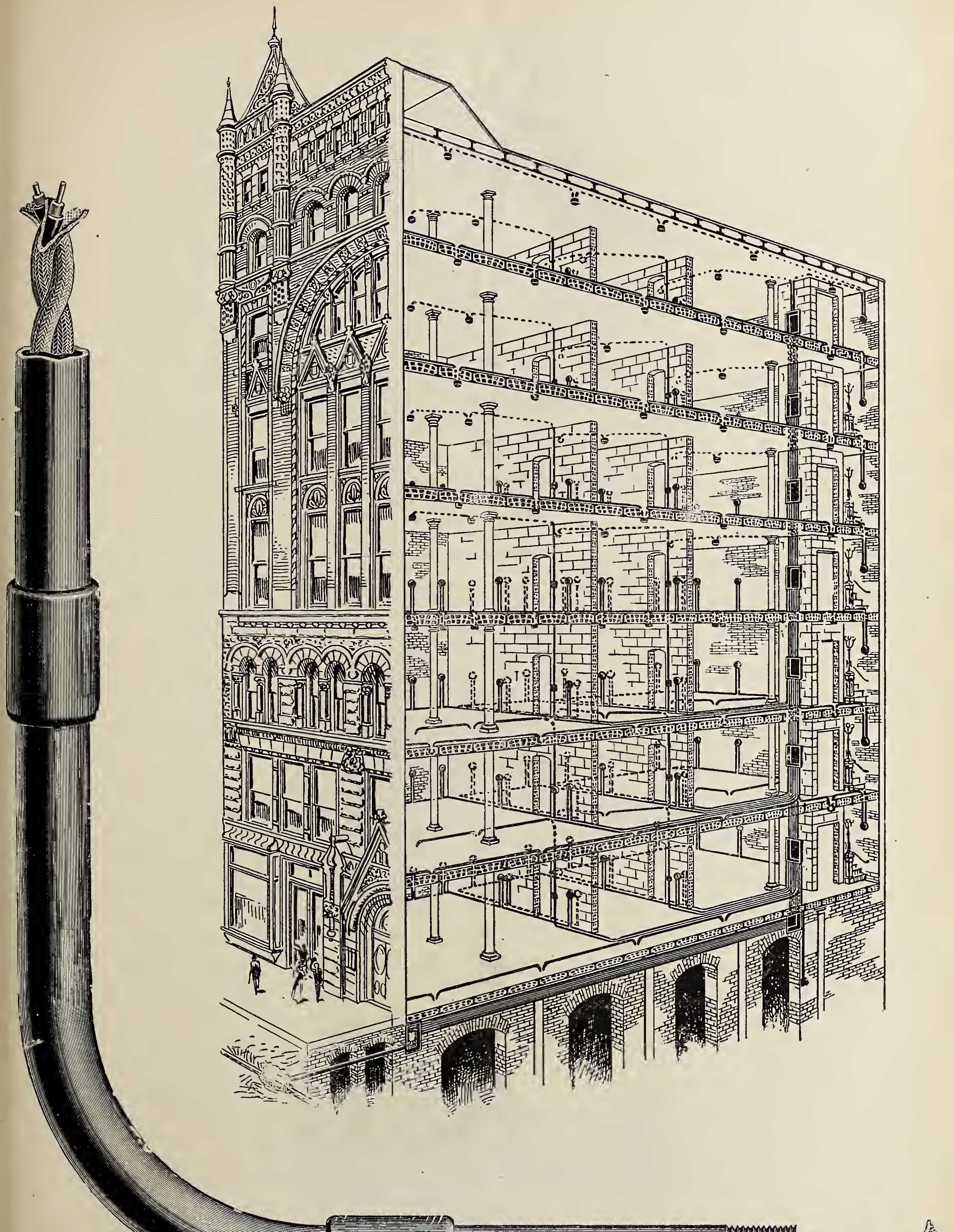
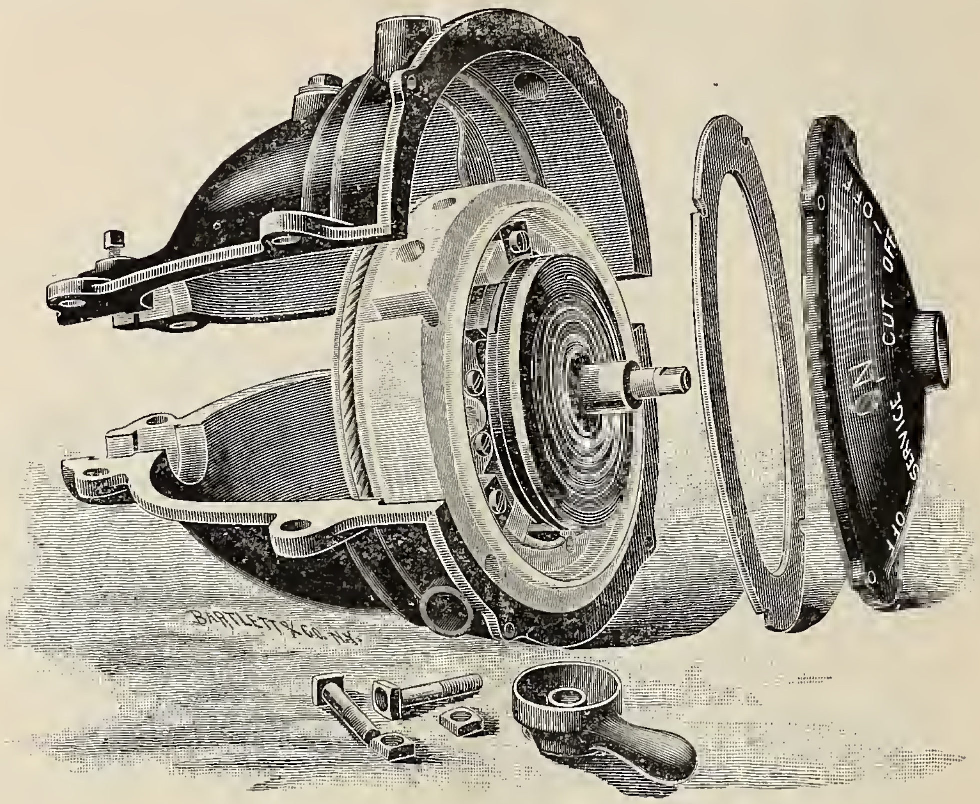


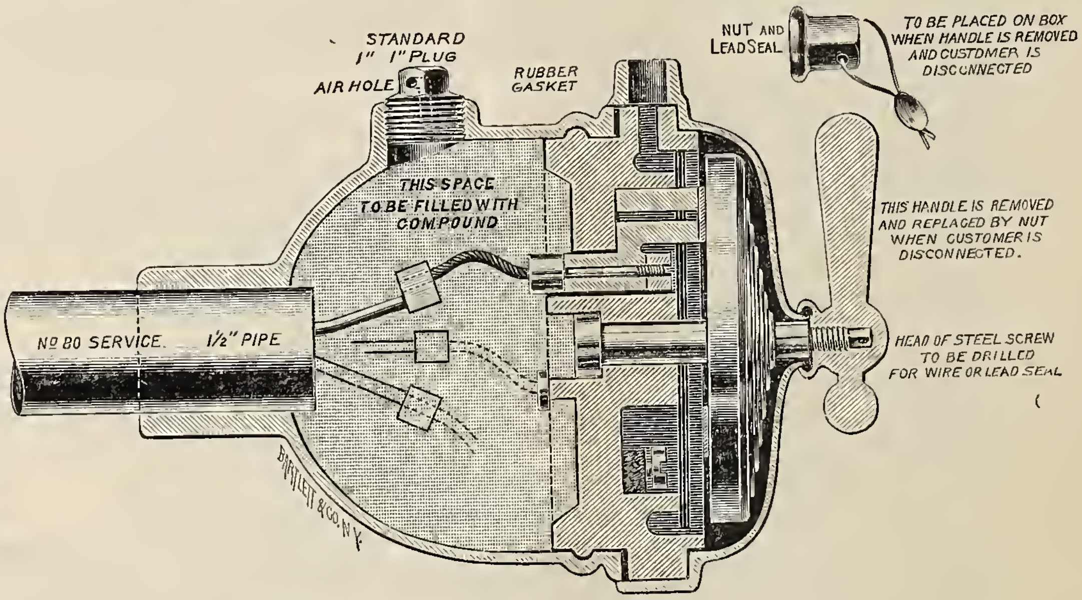
Diagram of an Iron Armored Insulating Conduit System in a Modern Fireproof Building.

subject to control independently of the lights in rooms. In this case, to accomplish the work economically (the three-wire system being employed), two separate sets of mains and risers of three conduits each were run from service cut-out through cellar to elevator shaft; thence on the inside of shaft (no channel or raceways on walls being provided) to top floor, all passing through the cut-out cabinets on each floor, and from these points the system was balanced in the usual manner; fuse blocks or panel boards and switches for controlling the branch circuits being placed in these cabinets, for both the office and hall circuits of each floor; the single tube system (two wires in a tube) being employed for all branch circuits.

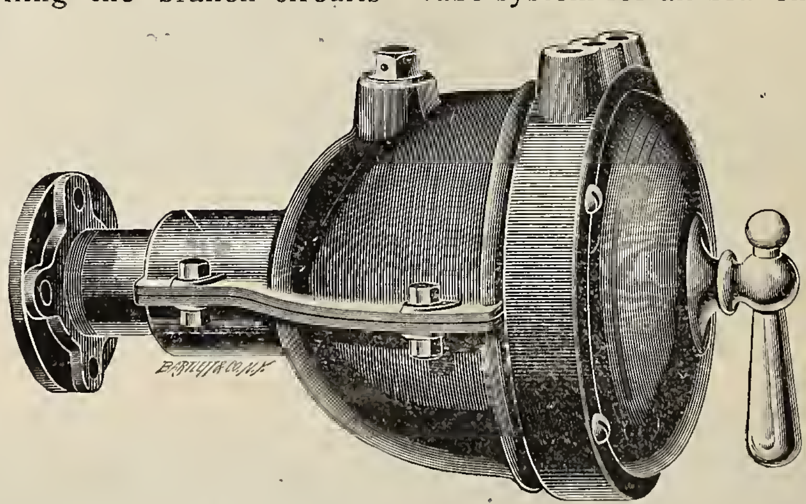
To avoid induction, when the alternating current is employed, it is absolutely necessary to run two conductors in a single iron-armored conduit. If the diameters of conductors are so large as to preclude their being placed in one tube, then it is the practice to run single brass-armored conduits for each conductor for mains or risers, making the connections to cut-out cabinets and junction boxes by the use of combination nipples of the required size, and from these points continuing with the single tube system for all branches or taps.



Johnson-Van Vleck Service End Cut-out.



Cross Section of Johnson-Van Vleck Cut-out.



Johnson-Van Vlect Cut-Out Assembled.

We illustrate the improved service end and cut-out of the interior conduit and insulation company, which is being generally called for in architects' specifications, as

well as required by underwriter associations. It is placed at the inlet of the three-wire system to buildings, and is the point at which all the circuits for light and power are controlled. In case of fire, the cut-out is accessible to firemen. Its advantages over a triple break-down switch are apparent, as it is thoroughly waterproof. The switch is almost always placed in a location where there is more or less dampness.

The application and method of installing the cut-out are generally evident on inspection. The piece of pipe enclosing three conductors embedded in insulating material is a standard article of manufacture, as are the flexible conductors used within the iron case.

In installing, first attach the flexible conductors to the terminals projecting from the conduit—take the porcelain base out of the cast-iron case, remove the switch spring disk and connect up, using proper fuses, and carefully solder conduit terminals to flexible connector. Pack the porcelain base with any convenient packing—we recommend using sisal rope, and furnish same with the cut-out. Put the two halves of the iron case together with their flange bolts, remove the plug at top of the case and fill in with insulating compound. Connect the risers through the three outlets provided for that purpose and pack the outlets as they pass through the iron case to insure a tight joint.

—U. J. Hungerford, No. 29 Chambers street, N. Y., connected with Wallace & Sons for the past 25 years, is N. Y. sales agent for the Coe Brass Manufacturing Co. He handles their copper wire, extensively used for electrical purposes.

—The services of Chas. F. Reinman, an expert chemist and well-known lamp maker, have been secured by the Standard Lamp & Novelty Co., 248 W. Twenty-third street, N. Y.

—The Standard Electric Lamp and Novelty Co.; No. 248 W. Twenty-third street, have just issued their new catalogue with over 200 engravings of miniature incandescent lamps and electrical novelties.

The contents of this catalogue are of such a nature that whatever is required for expert or special work in the line of lamps may be at once found. Fancy lamps for general house lighting, fancy dances, floral or ball room decorations are but a few of the kinds they manufacture.

For Christmas holidays nothing is more desirable than miniature lamp decorations of pretty colors.

Their price is very satisfactory to all dealers. Write for one of their new and fully illustrated catalogues.

POSSIBLE CONTRACTS.

Augusta, Ga.—There will probably be another electric light company organized and a plant erected.

Brunswick, Ga.—The city intends erecting a new electric light plant. Address J. B. Abrams, chairman.

Shreveport, La.—W. K. Henderson will put an electric lighting plant in his factory.

The mayor will put an electric light, refrigerating and ice plant in the market-house building. Proposals are wanted for the same.

Ferguson, Mo.—A duplicate plant will be erected by the Olive Branch Electric Light and Supply Co.

Ballinger, Tex.—Prices on machinery for electric light plants are wanted by the Ballinger Manufacturing Co.

Jacksonville, Ala.—A sixty-light dynamo for lighting plant is wanted by the Jacksonville Textile Mill Co.

Norfolk, Va.—The Monticello Realty Co. will buy an electric plant for a hotel. Address D. Lowenberg, president.

Brooklyn, N. Y.—A new warehouse and wharf are being erected by the Mollenhauer Sugar Refining Co., to cost about $75,000.

Philadelphia, Pa.—Harry Peale, Harrison Building, is making sketches for a large residence to be built at Bala, Pa. It is to be built of stone and frame. The cost must not exceed $10,000, including the following: Hot water heating, electric combination gas fixtures, electric wiring and bells, and speaking tubes.

The Philadelphia Pure Rye Whisky Company, Bourse Building, are letting separate contracts for a six-story warehouse which is to be built at Eddystone, Pa. It will be constructed of brick and iron, and when completed will measure 80 feet by 120 feet. The cost will probably be $30,000, including all sub-contracts.

New York City.—Mrs. William T. Fitzgerald intends to improve the large plot at the northwest corner of Broadway and Thirty-seventh street. The new building will consist of but two stories and will be completed by spring.

The newly organized Richmond County Electric Company is preparing to illuminate the squares in Port Richmond, New Brighton and Stapleton with powerful lamps, free to the villages.

Berlin, N. H.—Additions are being made to two manufacturing plants, causing the outlay of nearly a million dollars; the Glen Manufacturing Co. being the greater, a paper plant, and the other being Burgess Sulphite Pulp Company.

Gloversville, N. Y.—Messrs. Smith & Parkhurst, owners of the D. M. Smith hair mill, which burned recently, have decided to rebuild and are now having plans drawn for the building. The designs call for a three-story structure and a boiler house. The machinery will be of the latest improved pattern.

Boston, Mass.—Plans have been completed by Winslow & Wetherell for a large mercantile building, which the estate of the late Thomas E. Proctor will erect on Fulton, between Barrett and Cross streets. They call for a five-story structure of mill construction.

Philadelphia, Pa.—The Enterprise Manufacturing Company is to erect a large building for the manufacture of hardware, and will install a line of machinery.

A big factory for the manufacture of graphite and black lead will be erected for E. B. Seidel, at Dobbins and Milnor streets. The dimensions of the factory will be 50 by 150 feet, two stories high. It will be equipped with the most improved machinery. The building alone will cost $25,000.

New York City.—Isaac White, of 196 Lenox avenue, will erect two five-story brick flats, to cost $60,000.

Ludwig Baumann will erect a three-story brick store and office building at No. 268 W. Thirty-sixth street, to cost $15,000.

Paterson, N. J.—A contract with John W. Ferguson, of this city, for the construction of a three-story brick mill for Pitkin, Houldsworth & Co., woollen manufacturers of Passaic City, has been filed at the County Clerk's office. The contract price for the new building is $36,500.

Albany, N. Y.—James G. Newbury is putting up a new building on the site of the old Van Bergen mill, recently burned, to be used as a power house in connection with his electric plant.

NEW CORPORATIONS.

Camden, N. J.—The Pneumatic Telephone Attachment Co. and the Berkeley Coal Co. have been incorporated.

Brooklyn, N. Y.—The Ajax Electric Manufacturing Company has been incorporated for the manufacture of studs, hooks, eyelets and electric appliances. Capital $50,000 ; Directors, T. C. Roberts Horsefield, of No. 51 Windsor place, Brooklyn; Arthur S. Willdig and W. D. Spelman, of Brooklyn.

New York City.—George B. Inman Contract Company of New York City has been incorporated to contract for the construction of water-works, gas and electric light works, electric railroads, etc. Capital, $10,000. Directors, Geo. B. Inman and Edwin L. Hunt of New York City, and George Froh of Brooklyn.

Notfolk, Va.—The Portsmouth & Cornland Telephone Co. has been incorporated with a capital stock of $10,000. C. R. Johnson, president; Annie Hodges, secretary-treasurer. To construct telephone lines in Virginia and North Carolina.

ELECTRICAL and STREET RAILWAY PATENTS.

Patents Issued August 18, 1896.

565,913. Electric Car Lighting. William J. Morden, Chicago, Ill. Filed October 22, 1895.

565,930. Construction of Dynamo-electric Machines. Sidney H. Short, Cleveland, Ohio. Filed May 4. 1896.

565,931. Armature Winding. Sidney H. Short, Cleveland, Ohio. Filed May 4, 1896.

565,933. Signaling Apparatus. Arthur P. Smith, Springfield, Mass. Filed March 10, 1896.

565,937. Electric Brake. Elmer A. Sperry, Cleveland. Ohio. Filed February 16, 1895.

565,938. Power Transmitting Gearing for Electric Railway Trucks. Elmer A. Sperry, Cleveland, Ohio. Filed April 13, 1896.

565,939. Controller for Electric Railway Cars. Elmer A. Sperry, Cleveland, Ohio. Filed April 23, 1896.

565,952. Apparatus for Producing Ozone and Luminosity by Electricity. Emile Andreoli. London, England. Filed April 3, 1895. Patented in France April 14, 1892; in Belgium June 2, 1892; in England November 14, 1893; in Germany November 16, 1893, and in Switzerland February 24, 1894.

565,953. Apparatus for Indirect Electrolysis. Emile Andreoli, London, England. Filed April 9, 1895. Patented in Belgium September 25, 1894, and in England March 8, 1895.

565,965. Telephone Registering Device. John Curran, San Francisco, Cal. Filed July 1, 1895.

565,968. Telephone System. George F. Durant, William W. Dean, St. Louis, Mo., William A. Childs, New York, N. Y. Filed April 10, 1896.

565,971. Electric Arc Lamp. Henry J. Fisher, London, England. Filed February 26, 1896.

565,985. Underground Trolley System. Joseph Hoffman, Schenectady, N. Y. Filed September 20, 1895.

566,011. Lightning Arrester. Ernst G. P. Oelschläger, Charlottenburg, and Karl O. F. Schrottke, Berlin, Germany. Filed April 17, 1896. Patented in Italy March 4, 1896.

566,022. Telephone. C. A. Ernst Ruebel, St. Louis, Mo. Filed July 25, 1895.

566,035. Contact Device for Conduit Electric Railways. Max Stobrawa, Dresden, Germany. Filed April 10, 1896. Patented in England March 21, 1895; in Italy April 12, 1895; in Austria June 1, 1895; in Hungary June 18, 1895, and in France June 21, 1895.

566,045, Insulator for Electrical Purposes. Alfred J. P. Whitaker and Frederick G. Treharne, Llanishen, England. Filed September 3, 1895.

566,064. Insulation Protector. George B. Damon, Lowell, Mass. Filed July 8, 1896.

566,070. Apparatus for Controlling Motors. Stephen D. Field, Yonkers, N. Y. Filed June 18, 1892.

566,087. Electrical Advertising Device. John J. McCormick, Brookline, Mass. Filed January 25, 1896.

566,103. Electric Dental Apparatus. Harry F. Waite, New York, N. Y. Filed April 16, 1896.

566,120. Electric Generator or Motor. Charles E. F. Ahlm, Cleveland, Ohio. Filed May 16, 1896.

566,161. Trolley Wheel. Martin C. Furstenau, Detroit, Mich. Filed February 24, 1896.

566,193. Extension Electric Lamp Holder. Eugene C. Kuenneth, Gustave Schreier and Charles Kuenneth, Mount Olive, Ill. Filed January 21, 1896.

566,231. Electrode for Electrical Apparatus. Wilhelm Schäfer and Arthur Heinemann, Berlin, Germany. Filed October 8, 1894. Patented in Austria July 27, 1894, and in Luxemburg September 15, 1894.

566,235. Water Alarm for Tanks or Boilers. George V. Sheffield, New York, N. Y. Filed April 10, 1896.

566,252. Trolley for Electric Railway Cars. John Van Hoogstrate, Chicago, Ill. Filed March 31, 1896.

566,283. Automatic Signal Lamp for Electric Railways. David O. Beckwith, St. Louis, Mo. Filed April 29, 1895.

566,285. Electric Incandescent Lamp. Francis M. F. Cazin, Hoboken, N. J. Filed July 24, 1893.

The Electrical Age.

Vol. XVIII., No. 14. NEW YORK, OCTOBER 3, 1896. Whole No. 490

G. E. 800 Railway Equipment, Two Motors With Five Loaded Cars.

Nuatasket Beach Car—Third Rail System.

ELECTRIC RAILWAY INSTALLATIONS.

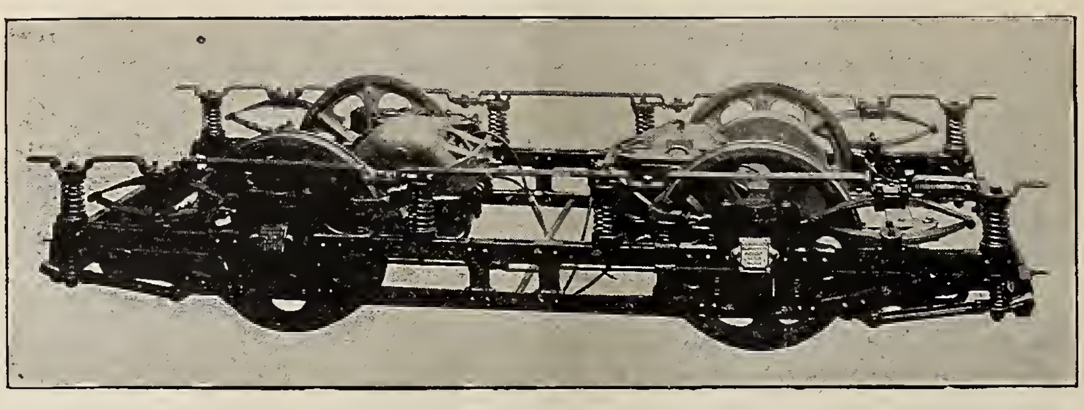
LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The great increase of electric roads in this country clearly shows that the experimental stage has been passed. There have been many millions of dollars invested in this species of traction that have proved a source of profit to the capitalist. In the steam railroads of this country a decrease of thirty-three millions of dollars has

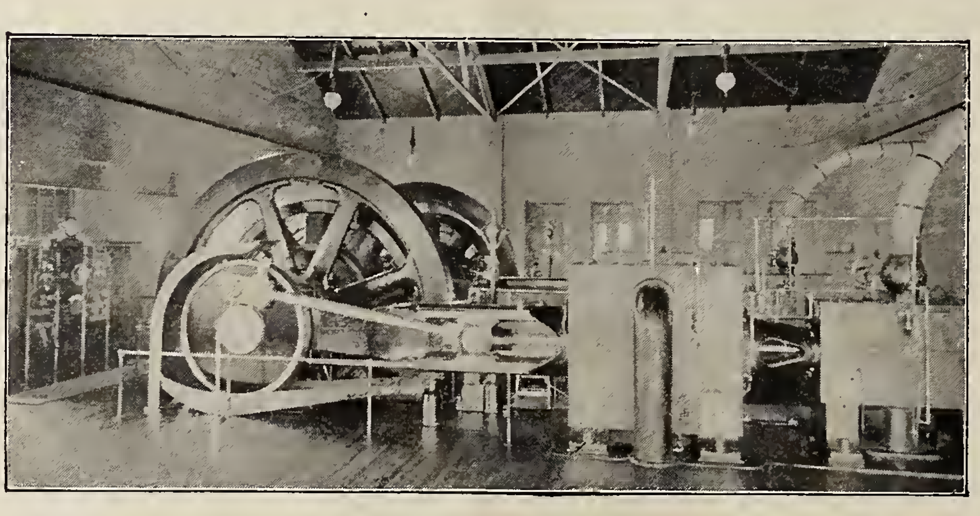
taken place in passenger receipts.

The essential parts of a railway installation may be enumerated as—



G. E. 1000 Mounted on Truck.

Power house,
Track,
Car equipment.



Interior of Nantasket Beach Station.

Each of these constitute a department of engineering that calls upon the greatest skill and experience to perfect.

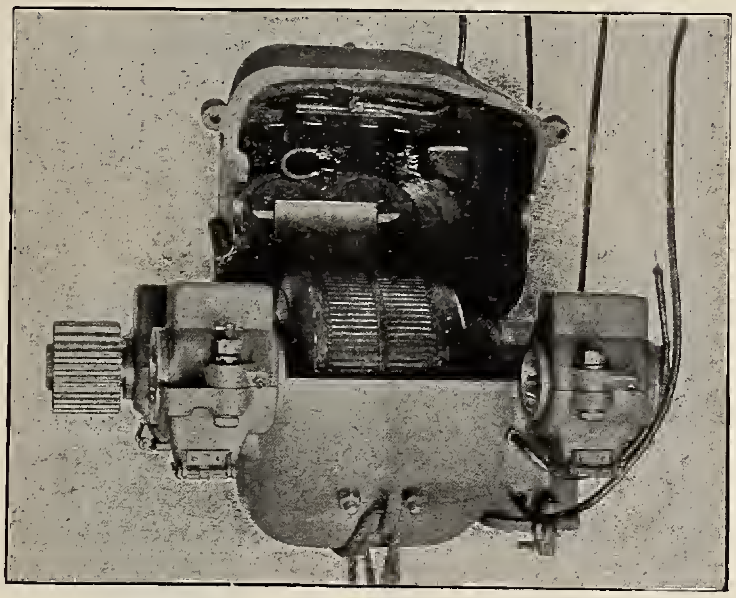
Nantasket Beach Car Barn.

Power House.—In the power house losses may occur which will at the end of the year be so effective in reducing the earnings of the road that its stockholders will imagine it a bottomless pit for all their wealth. On the other hand the great assistance given by an economically run power house to the yearly receipts will evince itself by the fact that dividends will be frequently and liberally distributed.

To make a power house pay, or to run it under conditions that are favorable, an examination of the

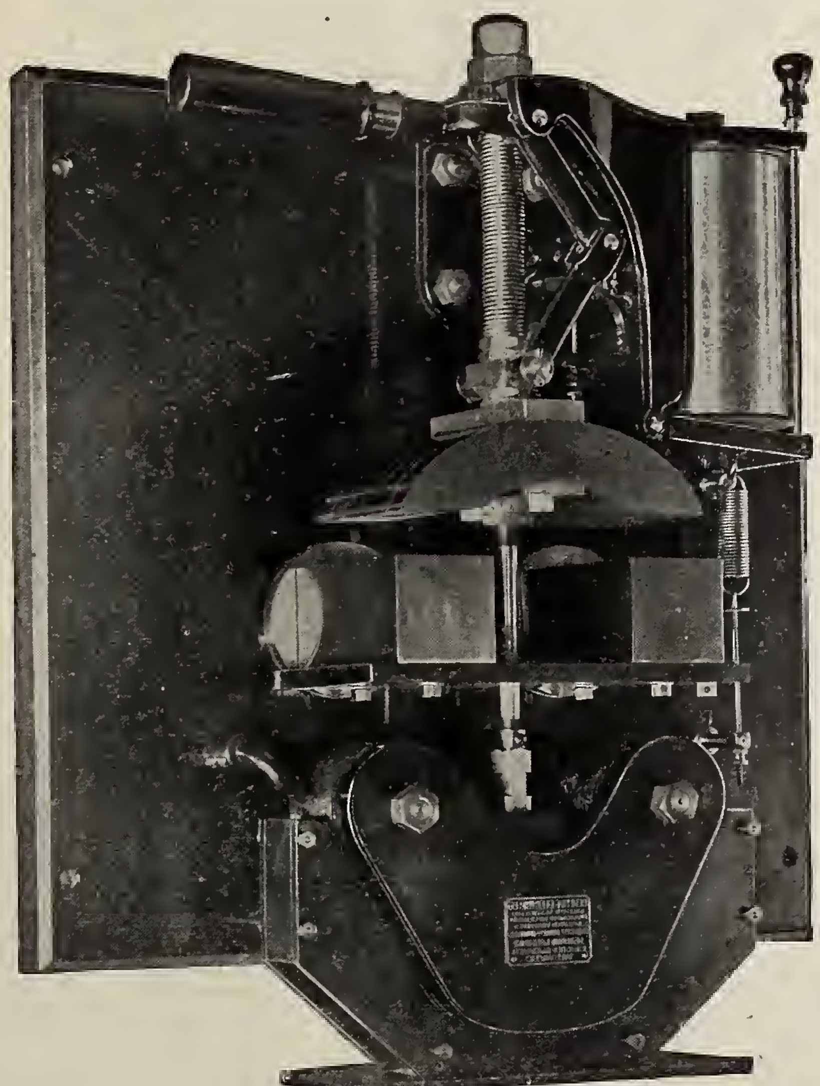
Fuel,
Boilers,
Engines,
Dynamos,
Labor,

must be successively made. It may so occur that the machinery installed requires too much attendance and a large salary list is the consequence. Repairs and additions are of consequence in addition. The cost of fuel



G. E. 1000 Open.

is so very important an item to consider that it may well be said that its consumption determines the expense of operating the plant. Coal is costly because it requires transportation; the less there is of this the more money is saved. Boilers have been so improved that it is possible to burn the refuse of coal heaps, the culm that aggregates in tons near every mine. The cheapness of the



Automatic Circuit Breaker.

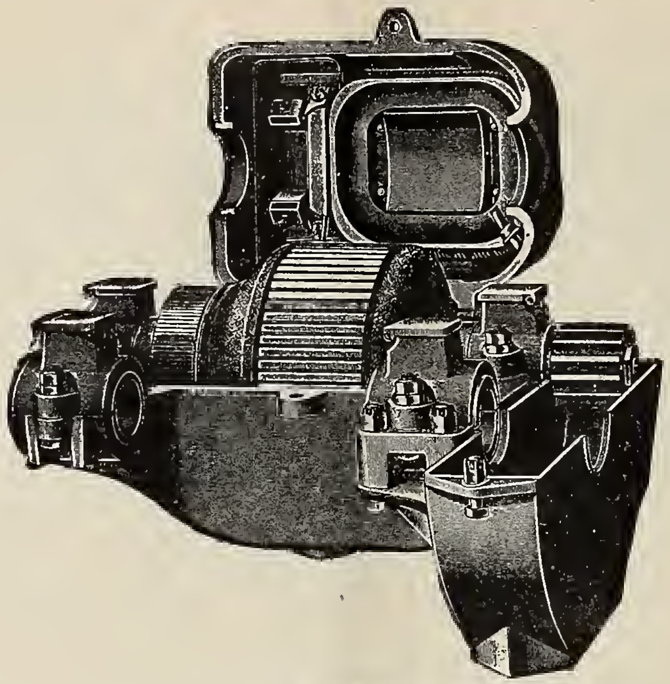
fuel depends upon the location of the power house. If electric light stations were situated near large mines the power would be much cheaper than at present, provided the scale of distribution was large enough. To produce the current with economy the station must be near the railroad or mine and consume cheap fuel.

Limits of distance are of course to be considered. The cost of feeders, etc., in an installation whose power house is far removed from the track would be considerable.

Boilers.—The boilers used must be of a kind that can consume cheap grades of coal, that will not be difficult to clean, and whose soot is not so considerable that their use is impossible. The nature of the water may have a serious effect upon the boiler; briny water leaving heavy deposits behind, the removal of which endangers the boiler shell.

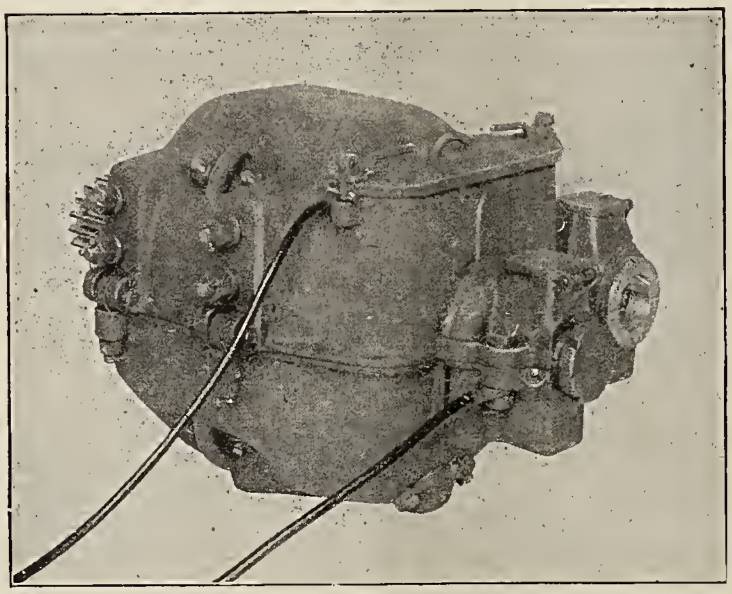
Engines.—In earlier days engines that would do considerable work, but in a wasteful manner, were employed. On modern engines an indicator card shows changes going on within; whether the steam is entering in quantity and not properly expanding, or whether the required amount enters and delivers up its energy. In other words, the engine of a power house should use its steam to the best possible advantage. The frequent and heavy changes of load must be met without incurring changes of speed. The point at which the steam is cut off should touch as much upon the point of economical expansion as upon the point of sufficiency for heavy demands of power.

It is generally conceded that steam tends to expand differently with different pressures; it is therefore best to allow expansion to occur to an extent compatible with each particular pressure. The experience of the engineer will lead him to this point in daily practice.



Standard Railway Motor.

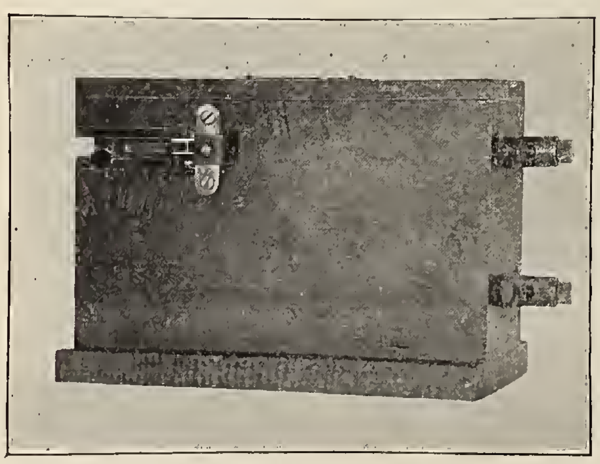
It is not the quantity of steam generated or the amount consumed by the engine that brings economy, but the extent of its expansion.



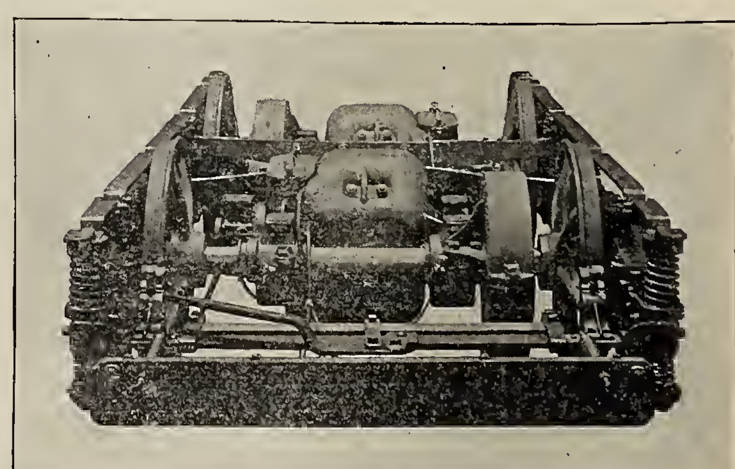
G. E. 1000.

Track.—Power is wasted in the outside of the station as well as within. It may be lost due to

Leakage,
Poor bonding,
Bad feeding,
Inefficient motors.



G. E. 1000 Mounted on Truck.



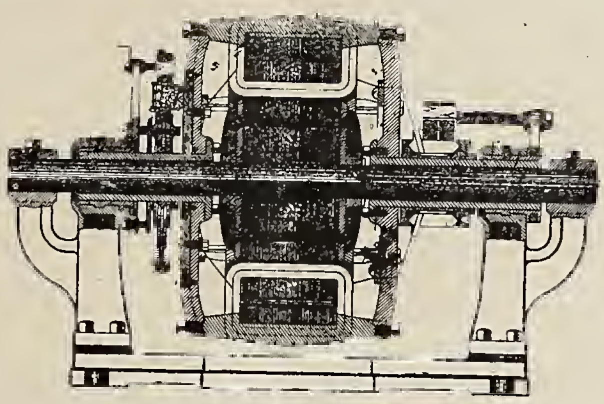
Railway Lightning Arrester.

The leakage is a matter of insulation; to keep the road free from heavy grounds is a matter that is neither difficult nor impossible, if ordinary care be bestowed upon it. The bonding of the track is the connecting of one rail to another by a conductor of sufficient size to prevent a drop of potential at each junction. The fish-plates connecting rail to rail are not sufficiently good. Copper conductors are used in addition; as they corrode and otherwise deteriorate, the loss may be considerable. They introduce resistance, lose pressure and waste power if not properly installed and attended to.

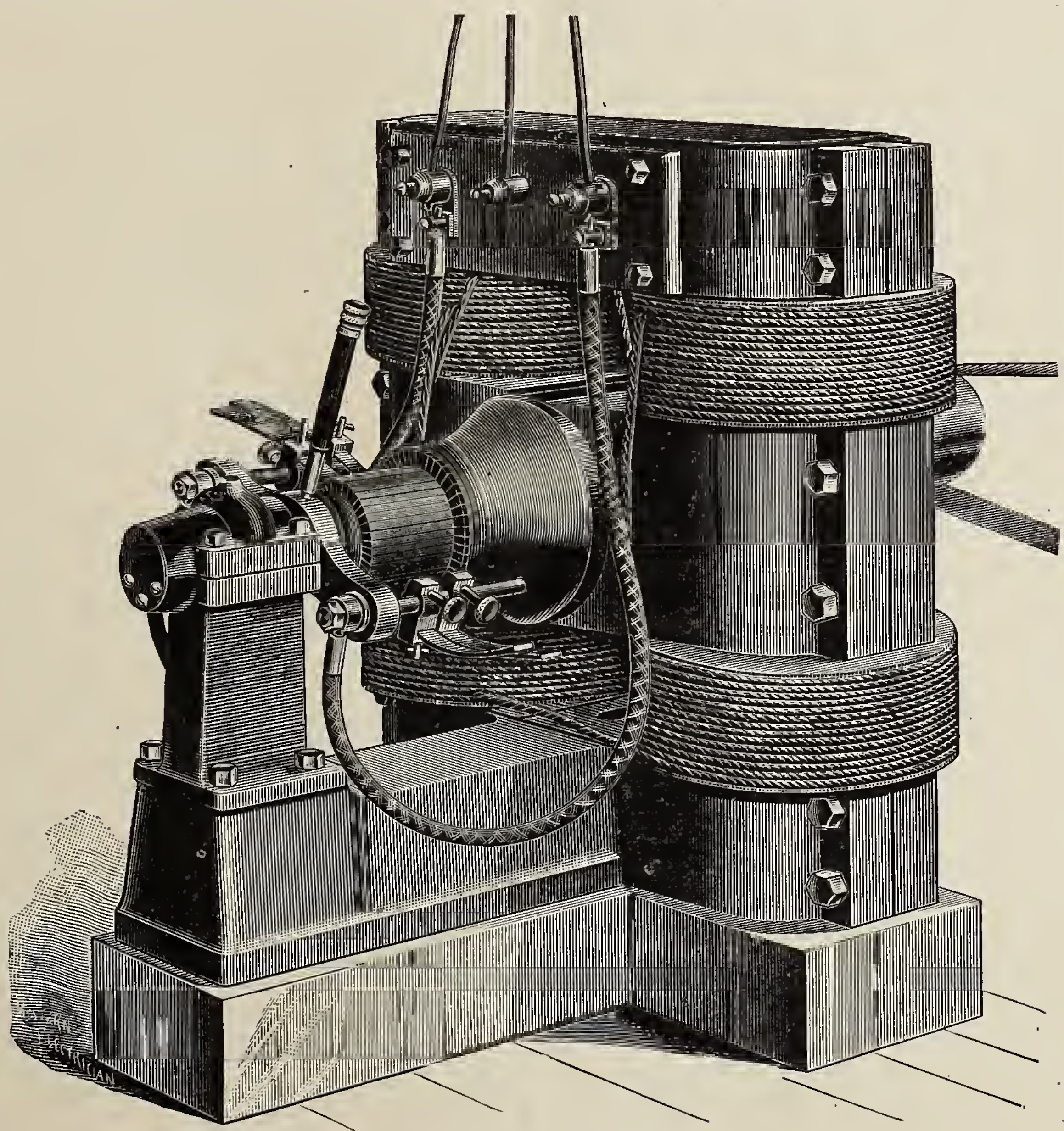
The trolley line is supported at intervals along the line by feeders—heavy copper conductors that run from the power house to different points of the line. The tracks, if well bonded with copper, being grounded, will be an

excellent return. The trolley line is not so well situated; it depends upon the feeders for the maintenance of its pressure, and these feeders will have to be heavier the poorer the bonds.

Motors—The efficiency of the motors is a point of great consequence in the outfitting of a railroad. The two electrical features are the generator and the car motors. If each were of an average working efficiency of 80 per cent., without considering other losses the balance of power would be 64 per cent.; additional drains due to leakage, bonding, feeding station losses, etc., would reduce these figures in practice to about 40 to 45 per cent. as the total efficiency of installation. Motors that do not wear well because of bad design will be a continual source of trouble. This item of expense, repairs, must be kept down to its lowest point and can only be reduced by using motors that represent the best design and practice of the day.



Cross Section of Motor.



Finished Commercial Type of Motor.

DESIGN OF A MOTOR.

The design of a shunt motor or dynamo differs each from the other in this respect: the dynamo is to be used for the production of current; the motor for the production of power.

To generate current, a magnetic circuit and conductors are required. A dynamo is merely one form of apparatus that produces electrical energy by electromagnetic means. A motor, as a source of mechanical energy, must have some means of regulating its output of power in proportion to the work required of it. This is automatically done from within with a precision that is remarkable.

If the armature of a motor is supplied with 1,300,000 lines of force, 220 inductors, runs at 40 rev. per second, the pressure it requires is

$$\frac{1{,}300{,}000 \times 220 \times 40}{100{,}000{,}000} = 114.4 \text{ volts.}$$

The rule being

$$\text{volts} = \frac{\text{speed per second} \times \text{lines of force} \times \text{inductors}}{100{,}000{,}000}$$

(Continued on Page 572.)

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 556.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

HEFNER LAMP.

Herr von Hefner-Alteneck* was led to the construction of the lamp which bears his name, as the result of his experiments upon simple benzine lamps. These lamps had round flames and large chimneys. With them he found excellent photometric results,using different grades of benzine as combustibles. He pointed out and insisted upon the necessity for using a combustible of known chemical composition. Accordingly an investigation was made of the intensity of the flames given by five fuels of different chemical composition, including among them commercial amylacetate. These showed only insignificant differences in intensity as long as the flames were adjusted to equal heights. He concluded from this that the height of the flame is the significant factor in defining intensities.

As a result of this experiment, he proposed the following lamp for giving a light of unit intensity. From a metal base projects a wick tube of German silver, 8 mm. in interior diameter, 0.15 mm. thick, and 25 mm. high. The flame height is adjusted at 40 mm. by the use of a "sight," or a Krüss' optical flame measure. The wick fills the tube without being compressed, and is arranged so that its height can be adjusted with nicety. Since the combustible, amylacetate, $C_7H_{14}O_2$, volatizes at a low temperature, the wick does not need to be brought up to the top of the tube and does not char. The lamp should be burnt at least ten minutes before being used for photometric purposes.

The results of his investigation of the effect of impurities in the amylacetate are shown in the following table:†

His conclusions were that variations in intensity due to the impurities which are most common are unnoticeable, while large variations from the normal are detectable through a change in the rate of consumption. Thus the rate furnishes a check both on the purity of the material and the intensity of the light.

Liebenthal‡ found that an increase or decrease in the diameter of the wick tube by 1 mm. caused a diminution of 1% in the intensity. Hence the given diameter corresponds to a maximum intensity. On the other hand, 1 mm. change in the height of the wick tube produced a corresponding change in intensity of only 0.2%.

He investigated also the relation between flame height and the intensity of the light emitted. Measuring the flame heights by a cathetometer, he found the mean error to be 0.08 mm. to 0.09 mm. Using the ordinary "sight," the mean error was 0.5 mm., which may increase to 1 mm. if the eye is fatigued. This is due to the disturbing influences of the non-luminous mantle about the point of the flame. From this cause large errors may enter. With Krüss' optical flame measure, the mean error was 0.3 mm., which corresponds to an error of 0.9% in intensity.

The mean variation of flame height during several periods of time was the subject of another part of his investigations. His results were as follows.

Between the 12th and 23d of October, the mean variation of the flame height of a lamp, A, was 0.32 mm.

Between October 24th and 29th the mean variation of A was 0.19 mm., and of B 0.035 mm. Between October 30th and November 30th the mean variation was 0.16 mm., for both A and B.

Finally, he found that the intensity of the Hefner light could be expressed, with a sufficient degree of accuracy, as a linear function of the flame height. For heights less than 40 mm., this is represented by the first of the following equations; for heights greater than 40 mm., by the second:

$$i = 1 + 0.025\,(h - 40).$$
$$i = 1 - 0.034\,(40 - h).$$

The exact relation which he found is shown in Fig. 14.

Investigations for the purposes of determining the value of the illuminating power of the German standard candle, in terms of the Hefner light, Lummer and Brodhun§ compared four Hefner lamps with a glow lamp. They obtained data in Table IX., concerning one of the lamps. These results show what degree of accuracy can be expected of this standard. From the intensity as given by them, the deviation of each set of measurements from the mean intensity has been computed, and this deviation has been reduced to percentages.

The intensities of the other lamps were as follows:

$$\text{Lamp } H_{I} \begin{cases} 0.3545 \\ 0.3569 \end{cases} \qquad \text{Lamp } H_{III} \begin{cases} 0.3539 \\ 0.3558 \end{cases}$$

$$\text{Lamp } H_{IV} \begin{cases} 0.3468 \\ 0.3455 \\ 0.3452 \end{cases}$$

Mean intensity of H_I, H_{II}, and H_{III} was 0.3547.

Mean error was $\pm$ 0.13 per cent.

The deviation of the intensity of Hiv from the mean of the other was 3%. The inner diameter of the wick tube of Hiv was 8.22 mm., and hence the deviation of its insity from the mean of the others confirms Liebenthal's observation, as noted above.

The conclusions which were reached as a result of the official tests of the Hefner lamp at the Reichsanstalt, are as follows:*

"Investigations have shown on the whole a favorable result. The intensity is not dependent upon dimensions of the lamp in such measure as to demand too much of the maker; the thickness of the walls of the wick tube is of importance, since if they are too thick the intensity is lessened, while if they are too thin the flame no longer burns steadily. A degree of purity of the combustible which the chemist cannot easily reach is unnecessary, while the impurities can be detected by simple tests. Less favorable is the dependence of the intensity upon the surrounding air, the presence of carbon dioxide having a strong influence. For the setting of the height of the flame either the 'sight' or the optical measure may be used; whichever is used, it should be adjustable."

Liebenthal† investigated the variations in intensity of the Hefner light as dependent upon hygrometric state, pressure and amount of carbon dioxide in the atmosphere. The method in which this investigation was carried out has already been indicated in our discussion of the Harcourt lamp. He took a series of observations extending through 12 consecutive months, of the intensity of the Hefner light as compared with a glow lamp, measuring each day the hygrometric state.

(To be continued.)

Electricity in India.—The temples of India are to be lighted with electricity, the example having been set by the great shrine of Siva, at Kochicaddie, near Mutwal, in Ceylon, and is to be speedily followed by the equally vast and ancient foundation of the Natukotta, in the same island. In no long time others will adopt the same improvement, till all the holy places of the peninsula are so equipped that by pressing the button they can be instantly illuminated like the modern hotel or theatre.

Note.—Tables VIII and IX referred to in this article will be printed in next week's issue.

* Elektrotechnische Zeitschrift, vol. iii., p. 445, and vol. v., p. 20.

† von Hefner-Alteneck: Electrotecknische Zeitschrift, vol. xxv., d. 323.

‡ Elektrotechnische Zeitschrift. viii, p. 504, and ix, p. 96. taken from Journal fur Gasbeleuchtung und Wasserversorgung.

§ Zeitschrift fur Instrumentenkunde, vol ix., p. 119. 1890.

* Zeitschrift fur Instrumentenkunde, vol. xiii., p. 257.

† Elektrotechnische Zeitschrift, vol. xvi., p. 655.

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CONTENTS.

	PAGE
EDITORIALS	
Compressed Air	571
A National Lubricant	571
A New Industry	571
GENERAL SUBJECTS	
Electric Railway Installations	565
Design of a Motor	569
Standards of Light	570
The Use of Old Rails as Underground Conductors	572
TRADE NOTES	
A Monster Carbon	573
The North American Electric Co	575
Wheeler Improved Surface Condenser	577
Canadian Letter	579
Possible Contracts	579
Telephone Notes	580
NEW CORPORATIONS	579
PATENTS	580
INQUIRY COLUMN	577

COMPRESSED AIR.

The use of compressed air for purposes of power and traction is heard of more frequently than ever. An article by Charles A. Hague in "Cassier's Magazine" speaks with considerable confidence of the probable headway it will make in the course of time. The writer states "the outlook for compressed air now is certainly as good as the prospects were for electricity fifteen years ago." It is, in our opinion, difficult to accept the truth of that statement. Fifteen years ago there were established systems of telegraphy all over the world; the telephone was in a state of advanced improvement, and the dynamo was recognized as the marvel of the day. We do not merely defend our own interests in saying this, but wish to show that the basis for prediction is so very much less in the case of compressed air to-day, for purposes of power, that its application is so limited it is impossible for one of conservative mind to give issue to such an opinion. Gisbert Kapp clearly states the objections to its use; he mentions the Popp system, of Paris, and in speaking of its efficiency, says "the efficiency of the Popp system at Paris, as determined by Prof. Kennedy, is only about 50% and that only under very special circumstances." Inherent failings in a system, of whatever description it may be, are insuperable objections to its use. The technical value of the apparatus used and the completeness of each part may give us an idea of the ingenuity exercised, but it can never remove from our minds the knowledge of those deficiencies which have and will prevent compressed air from becoming a popular source of power for traction or transmission.

Although electric canal boats have been tried in this country on the Erie Canal, Germany is about to afford the first installation of electric tug boats, which is to be carried out near Berlin on the River Spree. Electric power is particularly adapted to this service by local circumstances, in that there are a large number of bridges crossing the river, and ordinary barges are consequently unable to use their sails. The distance is seven and one-half miles, and it is proposed to establish a regular service of electric tugs, a trolley line supplying the power for the operation of the tugs. It is believed that the present charge for towing the distance will be halved by the new scheme.—Philadelphia Record.

A NATIONAL LUBRICANT.

It has been thought by many that the great law of progress does not affect nations; that its touch is seen only in the divergence of species—that mankind, grouped for purposes of policy or state, is exempt from its influence. This is not so. There are indications that the observing eye cannot fail to see; there are spontaneous movements that relieve the mind forever of its latent doubt.

In aggregations, individualities are not lost, but strongly thrust forward, thus characterizing the mass by the most prominent trait of each. The nation is merely an aggregation. Whether it be sentiment or an emotion that stirs the very chords of life, its seat is found in each breast; its voice is heard on every side. Mighty issues are required to stir the multitudes. There is no question that has been so frankly declared as that concerning the relative efficiencies of silver and gold.

The vast and intricate mechanism of social and industrial life is dependent upon a financial lubricant.

It relies upon the milled edge of coin to turn the wheels of state. The representatives of opposing factions are honest in their declarations. They individually believe in the use of gold or silver, as salve to heal the nation's sore. But, like the classes that range forward in science, literature and art, their opinions possess a quality depending upon the scope of each party's vision; depending upon its experiences and ingrained wisdom. So it is with the advocates of financial policies. Each in honesty proclaims the virtues of his national remedy. The point of view assumed, like the tops of high mountains, gives a broader and better prospect to the best qualified minds. Unfortunately there are but few that have risen to these heights. The best we can do is to listen to their description of the panorama below.

Sincere and honest men stir up only truthful impressions. The rest we build up in our imaginations. The time will soon be at hand when the land itself will eloquently declare the future rights of gold and silver.

A NEW INDUSTRY.

The improved illuminants, although competitors of our own lighting industries, have been received by electrical engineers with smiling grace. It is not confidence in their own methods of illumination which prompts this demeanor, but the satisfaction of seeing the standard raised. The acknowledged superior of the day is the arc light; following in its track is the incandescent lamp. We may place aside these two representative systems acetylene gas.

To manufacture acetylene an electric current is required; carbon is necessary and an attendant of electro-technical training. The manufacture of acetylene on a large scale would benefit the trade. It would require a constant consumption of carbon and the continual use of a heavy generating apparatus. The dynamo and carbon manufacturer would feed on the first profits of the industry, and some worthy engineer receive immediate occupation.

One of our most industrious firms are making quite a commotion by manufacturing great carbon blocks for this purpose. Their success is ours. By thus interlinking interests acetylene and electricity may prove boon companions.

The Longest Telephone Circuit.—The longest commercial distance at which the long-distance telephone is now operated is from Boston to St. Louis, a distance of 1,400 miles. This line is more than twice as long as any European telephone line.

(Continued from page 569.)

As far as these calculations go neither dynamo nor motor differ from each other in the calculation of the armature. But the action within each armature of dynamo and motor is entirely different.

A dynamo merely generates pressure because its armature turns rotate in a magnetic field. A motor receives current and its armature conductors likewise rotate in a magnetic field. It therefore seems that a motor receives and generates pressure at the same time. This is true. The faster the motor armature turns, the greater the pressure it generates, as though it were a dynamo. The outside pressure from the line, therefore, meets with opposition. It cannot flow through the armature uninterruptedly. When the load is heavy without, the armature sensibly diminishes in speed; this back pressure likewise; the line pressure is therefore able to send more current into the armature and help it pick up. The automatic action from within is therefore this back pressure, the electrical efficiency of the motor depends upon it.

$$\frac{\text{Back pressure}}{\text{Line pressue}} = \text{electrical efficiency.}$$

If the back pressure = 90 volts
Line " = 100 "
The electrical efficiency $= \frac{90}{100} = 90$ per cent.

The practical or commercial efficiency of the motor is ascertained by comparing the work done with the power supplied.

$$\frac{\text{Horse-power generated}}{\text{Horse-power supplied}} = \text{commercial efficiency.}$$

The back pressure in the armature is called the counter-electromotive force. The motor is doing its greatest work when the back pressure is one-half the line pressure.

THE USE OF OLD RAILS AS UNDERGROUND CONDUCTORS.

F. O. RUSLING.

While the writer was the superintendent of the Buffalo Railway Company, serious indications of electrolysis of the pipes within a half mile of the power house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made of the entire district. This was a long and difficult matter, since there were three systems of natural gas pipes, two of illuminating gas, one of water and two conduit systems.

Although the pipes were already connected to the negative bus-bar by large copper cables, it was found that these were entirely inadequate, and that there were two points where the pipes at heavy load were three to five volts positive to the adjacent rails. One of these points was 1,500 feet north and the other 1,800 feet east of the power house.

The expert calculated that, until extensive changes could be made in rail returns, the former point would deliver about 1,000 amperes and the latter about 3,000. To bring this current to the dynamos with but five volts loss would need over eight thousand dollars' worth of copper. While hesitating over this large expenditure, it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, centre-bearing rails, originally weighing 56 pounds to the yard, but worn down to 50 pounds or less; they were high in carbon, hard and brittle.

The best scrap price obtainable was eight dollars per ton, delivered. Our expert carefully tested their conductivity with 1,000 to 1,500 amperes, using an instrument reading to one-thousandth of a volt in order to secure accuracy. As the showing was satisfactory, he persuaded us to let him try the rails on the 1,500 feet length, which would require four rails in parallel to give the desired results.

As he guaranteed to bond them so as to make a continuous conductor, he was allowed to go ahead. A trench was dug between curb and sidewalk and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back, and arranged so that the end of one rail was at the centre of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy. A steel washer one-quarter-inch thick, one and one-eighth-inch inside diameter and four-inch outside, was dipped into hot insulating compound and placed against one rail so as to inclose the contact spot. The hole in the washer was then filled with the Edison-Brown plastic alloy, inclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to bottom of trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transmit 1,500 amperes. When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum distillation much lighter than asphaltum and costing about twenty-five dollars a ton.

This four-rail conduit was connected up and carried at heavy load, 1,100 amperes, 1,500 feet with a loss of but four volts. This result was so surprising that our expert suspected his instruments were wrong and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct. To appreciate the magnificent performance of these old rails and their bonds I need only say that, to give the same result, it would require 3.55 square inches of copper, and 1,500 feet of this would weigh 20,532 pounds and cost at 12 cents per pound, $2,462.83. Our four-rail lengths weighed 50 tons and cost as scrap but $400.00. The resistance of steel as compared with copper is usually considered to be between 7 to 1 and 9 to 1, but this including 50 bonds in each length was about 5.63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail," and after a year's service they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this, even at $30.00 per ton, would be cheaper than copper as a conductor.

Our expert was then told to go ahead with the 14-rail conduit. As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted. In the power honse is an air compressor for cleaning out armatures and removing dust from the boiler house walls. An iron pipe was connected from the air reservoir to the yard and a single layer of rails, bottom up, was put on each wagon. Each load was carried into the yard and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop. To avoid drilling the rails, pieces of ¾-in. iron about 24 inches by 8 inches were placed in the trough every 15 feet.

These were bored at the ends for a pair of countersank ¾-in. bolts and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down.

The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate ¼-in. thick, 20 inches by

8 inches. On these more bonds, other layers of four and three rails and finally a ¾-in. by 24 ins. by 8 ins. top, bolting all layers together. The sides of the trough were but ½-in. from the rails between clamps, so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the 14 rails transmitted 3,250 amperes 1,800 feet with but four volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power house. The rails used in this conduit weigh about 210 tons, which at eight dollars would amount to $1,680.

It would require 12.48 square inches of copper to equal the 70 square inches of steel. This copper, figured at 1,000 feet by one square inch, weighing 3,854.2 pounds, would weigh 86,580 pounds, and at 12 cents per pound would cost $10,389. The total cost of the rails and bonds for both conduits was about $3,322, as against

J. S. Speer, Secretary Partridge Carbon Co.

$12,852 for equivalent copper. The labor to install the copper would of course be less, but on the other hand we had the rails in stock and the only actual outlay was for labor, bonds, lumber, bolts and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2,500, and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds I should not advise the use of buried rails for conduits if copper is used for connections.

Even when new it is impossible to get the full conductivity of the rail, and the contacts get worse and worse as time passes.

The copper when covered with the damp earth will oxidize at a rate determined by the composition of the soil and the amount of current transmitted.

But following the lines indicated on our second rail conduit, any road with a lot of old rails on hand can cut down its transmission losses at a slight cost. This subject is well worth careful consideration on the part of railway managers.

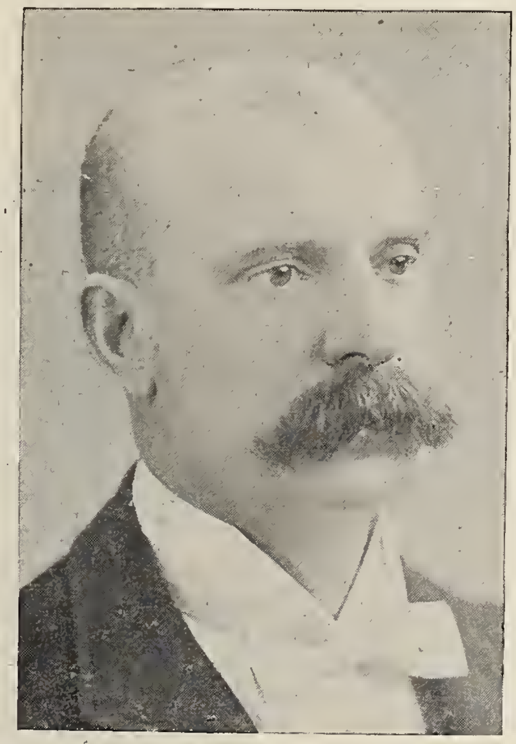
A MONSTER CARBON.

(THE PARTRIDGE CARBON COMPANY.)

Carbon and diamonds differ from each other by but a few per cent. The hard, black and unpretentious looking material can become by additional heat and compression the transparent, glittering gem. Diamonds are valuable because they are rare; still they merely consist of crystallized carbon gas. We are beginning to believe that the darker product, the more widely distributed of the two, is becoming the most valuable. It is entering into the industries of the world as an indispensable article.

We need it in our homes. It keeps away the chill of winter and even supplies the means of chasing away the shadows of night. Carbon and progress are almost synonyms today. We are therefore happy to know that the manufacture of even the latest illuminant, acetylene gas, requires the use of carbon. Electricity enters into its manufacture likewise. Lime and carbon are practically fused together by a powerful current. The product, calcium carbide, is the material from which acetylene is directly evolved. Gigantic carbon blocks are necessary for the wholesale manufacture of calcium carbide. The Partridge Carbon Co., of Sandusky, Ohio, have been turning out monster carbons three feet long, two feet wide and eight inches thick; weight, 400 lbs. Messrs. Partridge and Speer, the manager and secretary of this concern, consider this quite an achievement, as much on account of the size of this block as the peculiar use to which it will be put. They have been manufacturing carbon for motor and generator brushes of the finest quality, as well as battery carbons, for a long while, and in all cases have given unquestionable satisfaction. We can say this of those black carbon blocks, that the sparkle of a diamond cannot compare with the brilliancy they can give as incandescent or arc light, or as the main constituent of acetylene gas. The Partridge Carbon Company are adding a new department to their hitherto extensive field. They have made the King Carbon of the day.

—The "Insurance Press" contains an article in connection with Mr. J. Elliott Smith's trial before the fire commissioners, concerning the unreliability of our fire alarm systems in New York in comparison with those of



James Partridge, Manager Partridge Carbon Co.

other cities. After citing many cases, the following figures were given:

CITIES.	BOXES.	ALARMS.	FAILED.
New York, . .	1,289	4,874	101
18 Other Cities,	8,390	16,157	24
Totals, . .	9,679	21,031	125

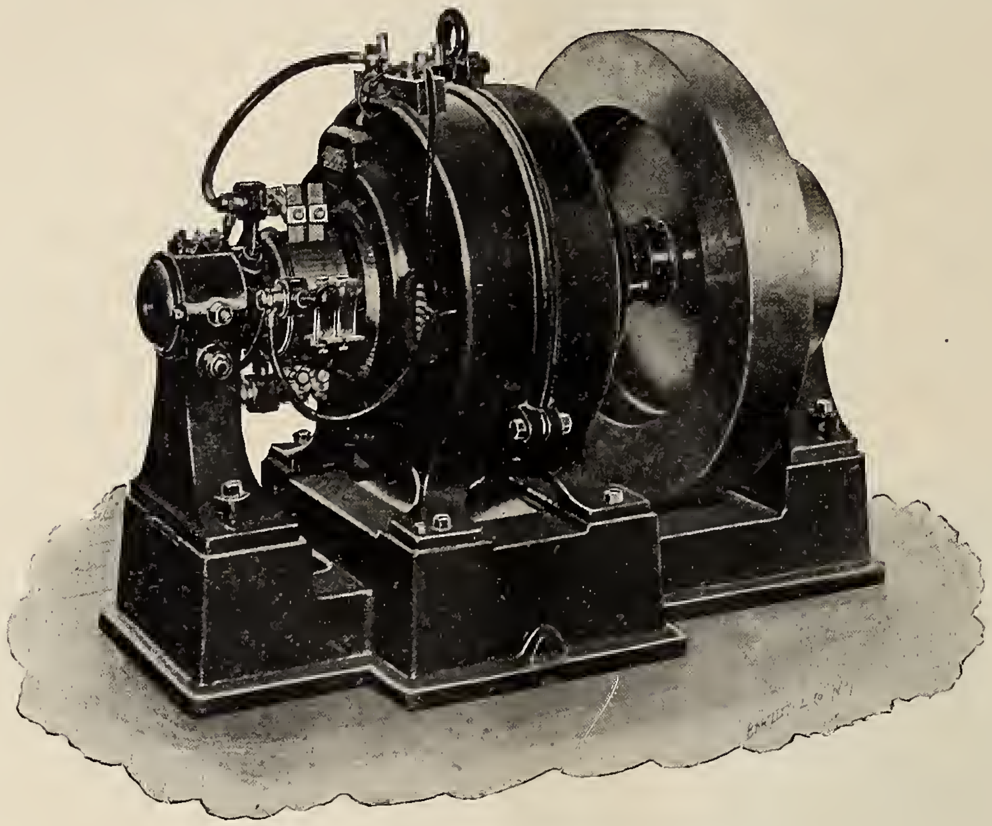
It seems painful to contemplate the fact that the fire underwriters know little or nothing about the system. A species of carelessness that is dangerous to the welfare

of the city exists in this city's fire telegraph departments. This investigation will change the conditions of affairs for the public benefit and security. It may be explained by the fact that all the present apparatus is moss grown with age—antiquated in principle and useless in practice.

The Chester Electric Co., now extinct, away back in the 60's furnished the call boxes now in use throughout the City of New York. Since that time but few changes have been made. The main difficulty with these boxes is that the springs are kept at a high tension. To make a successful call considerable power is required, in fact a muscular development attributed as a rule only to "one of the finest." If not pulled far enough down the wrong call goes into headquarters, and, if too frequently, a deplorable confusion results. It seems that during the past THIRTY years the New York Fire Department have been offered a box overcoming these difficulties—which cannot send in more than one call at a time, cannot call on a circuit from more than one box at a time, and which electrically cuts out all the other boxes until your call goes in. The reason is therefore evident why we are behind, and the disgrace should be fully visited upon the heads of those responsible for it. We understand, in addition, that the electrical mechanism of each box is entirely uninsulated from the iron case holding it.

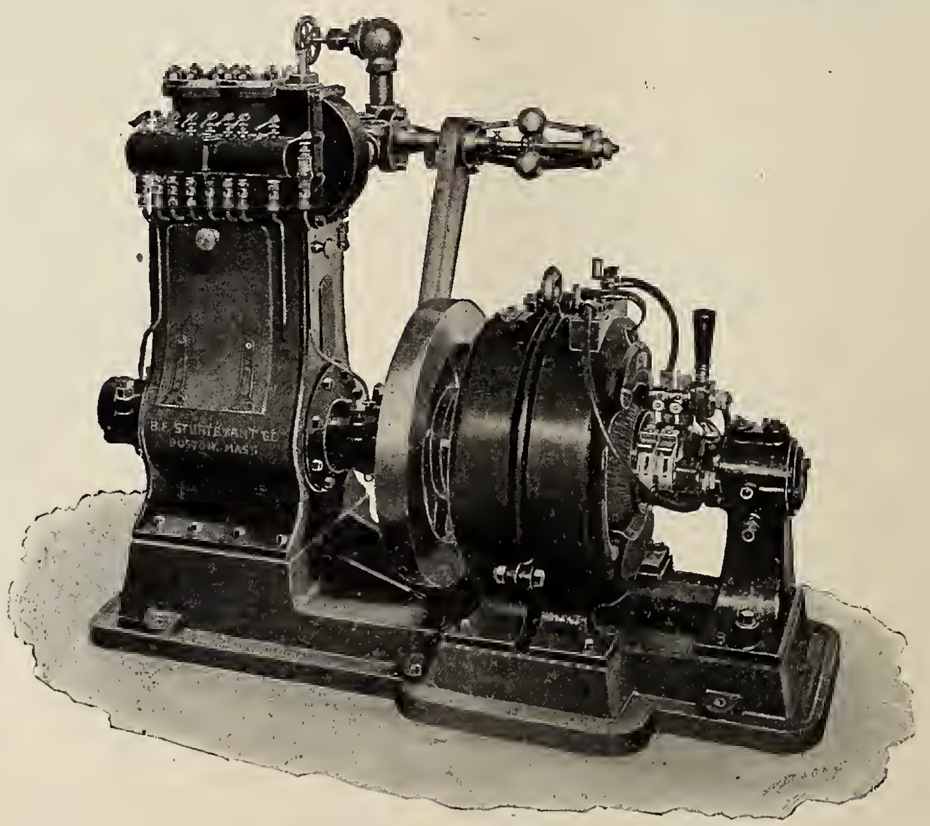
INTERIOR CONDUIT AND INSULATION CO.

We illustrate the Lundell compound wound generator direct-connected to two well-known high speed engines for lighting, power or storage battery service.



Lundell Generator for Gas Engine Service.

The Interior Conduit and Insulation Company have designed the equipments with a view of reducing to a minimum weight and the space occupied for the different outfits, rendering them especially desirable and eminently adapted for steam yachts, steamships, office buildings, residences, and all places where economy of space and noiseless operation is a desideratum.



Lundell Dynamo and Sturtevant Engine.

They have adopted the practice of making a solid coupling between the engine and dynamo shafts, and mounting the dynamo and engine firmly upon a cast-iron bed-plate. This construction insures solidity, absence of vibration and noiselessness of operation. It has been the practice for steamships and steam yachts to operate

generating sets with automatic cut-off engines; it is not infrequently desirable, however, in the case of steam yachts, cruising with a very high pressure and maintaining a very low pressure while in harbor, to employ a throttling governor capable of being readily adjusted for a difference of 100 pounds boiler pressure, thus operating the plant and providing light under low pressure while the fires are banked.

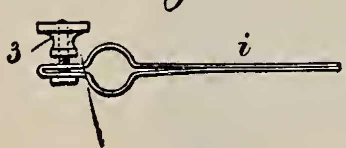
As they have used nearly all makes of engines in their direct-connected sets, including the Sturtevant, Case, Willans, Brotherhood, Armington & Sims and Cross engines, they are prepared to furnish plans and specifications for their Lundell generators direct-connected on a solid bed-plate to any engine whatsoever, either of the vertical or horizontal type. Although having found by experience that the very best results are obtained by rigidly connecting the engine and dynamo shafts, they are prepared to furnish or make any other style of coupling that may be called for.

The Interior Conduit and Insulation Company are producing a class of apparatus that cannot be beaten. Their offices and factory are at 527 W. 34th street, N. Y.

THE NORTH AMERICAN ELECTRIC CO.

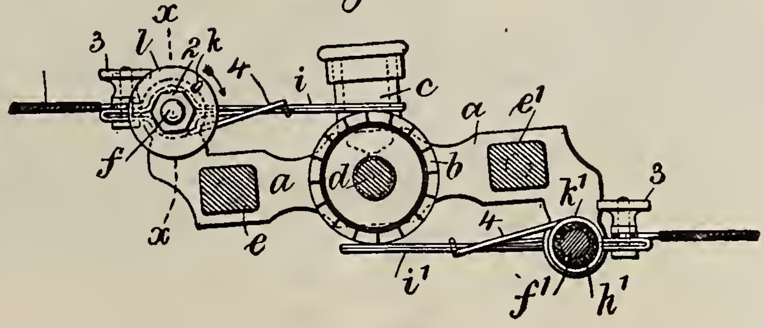
The North American Electric Co., No. 181 William street, New York, completed its fifteenth year in the elec-

Fig. 4.



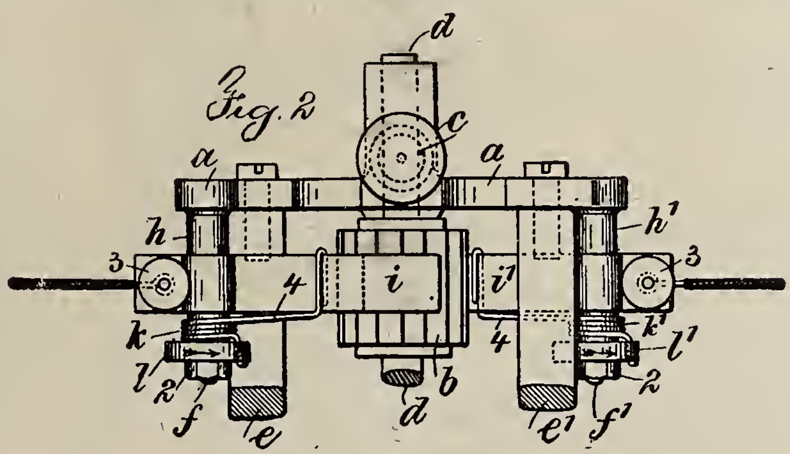
trical trade this past season. Although they have been working day and night to keep up with the rush, they have found time to put on the market three useful inventions

Fig. 1.



which are highly beneficial to their motors, and will insure their success in the future. The following statement is one of many they have received from their customers:

Fig. 2



"Mr. C. C. Dusenbury. president and manager of this enterprising company, is the patentee of the above useful invention. He is one of New York's well-known business men, and will bring the North American Electric Co. to the front rank, as he has succeeded in doing with his other enterprises."

Mr. E. C. Dusenbury, secretary and treasurer of the North American Electric Co., is a successful lawyer and an electrician of considerable ability.

Mr. J. E. Fuller, superintendent, is the inventor of the adjustable bracket. He has had twenty-five years' experience in the electrical profession, and is the inventor of several other valuable devices of an electrical nature.

There has been much trouble in regulating the pressure of the brush on the commutator in small motors, and they have brought out a new device by which all difficulty is obviated, and which gives to the North American motor a decided advantage over all others.

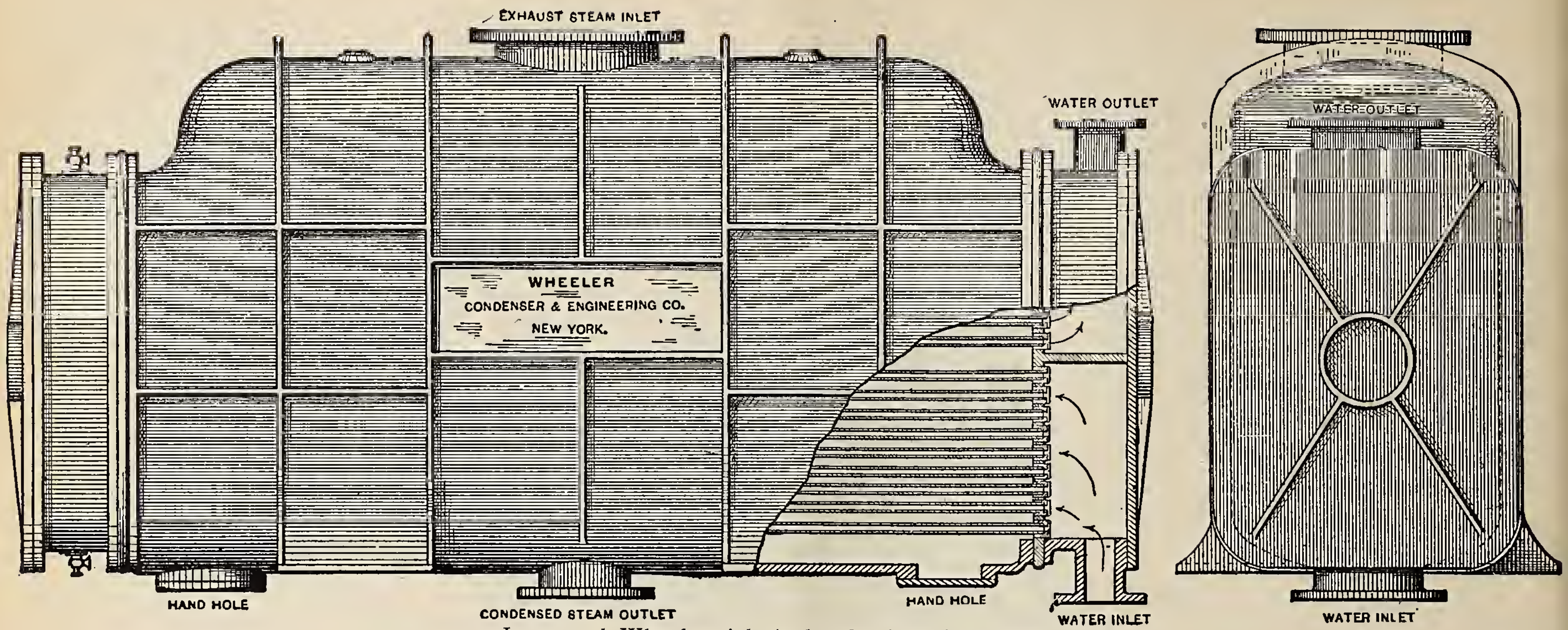
The cuts above will show the method of its working. It is applied to Nos. 3, 4 and 5.

c is an oil cup for lubricating shaft. The arms, *f* are firmly fixed to the end of frame *a*, and have threaded ends with nuts, 2. Upon these arms are insulated sleeves, *h*; helical springs surround the sleeves, one of which is so formed as to bear upon the brush, and the other end to pass through the disk (*l*) located also on the arm between the end of sleeve and nut. By turning the disk in the direction to press the brush upon the commutator, and clamping same in position by tightening the nut, the proper tension is readily obtained. The brushes may be easily slipped off, turned over if worn, or replaced by new ones, and adjusted without difficulty, overcoming the trouble and annoyance so common with the ordinary method in use on small motors.

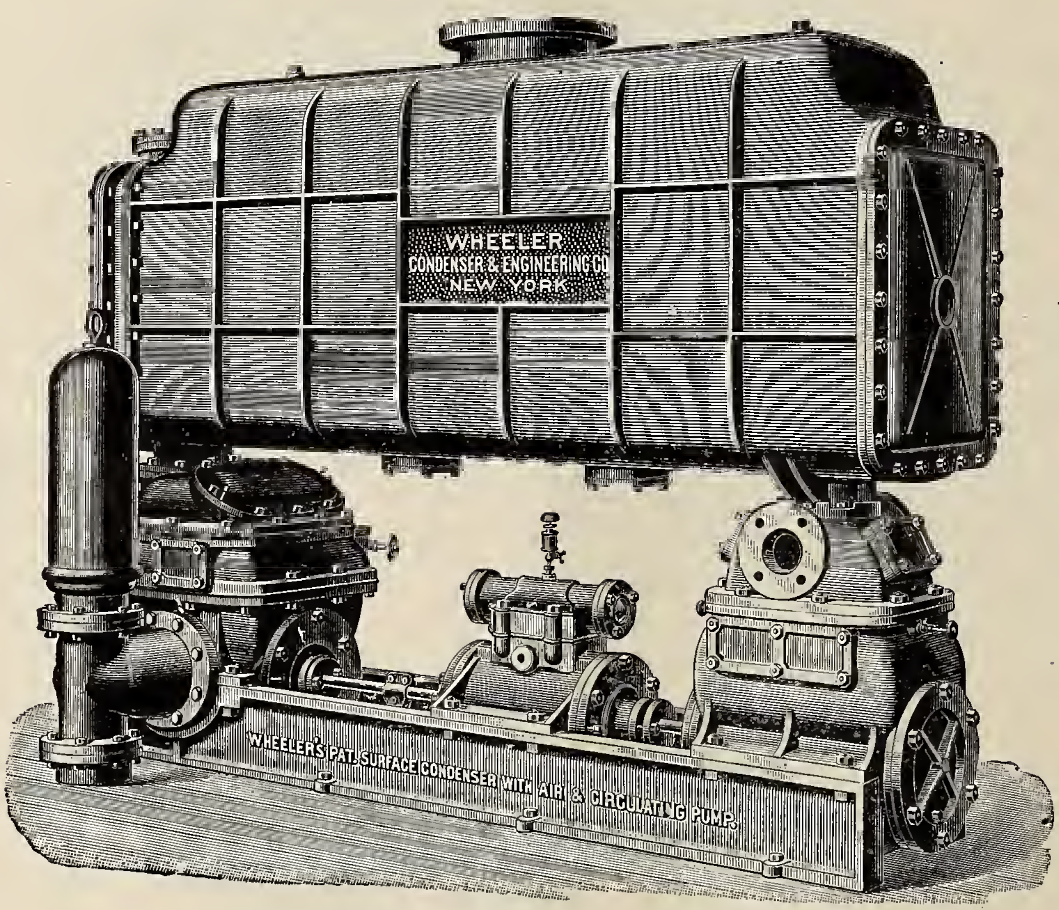
BOOK REVIEWS.

Complete Wiring Tables.—The best way of calculating the size of mains is perhaps the quickest way. This is true for all departments of wiring, elevator and pump work. The wireman or contractor cannot afford to spend valuable time in useless or inaccurate calculations. We have on hand a sheet of valuable tables. They are exact and immediately applicable to wiring as well as electric elevator and pump work. The wireman can improve himself by using them; the contractor save all doubts as to the proper capacity of an installation to do its work. The price of these tables is $1.00; sold by the Electrical Age Pub. Co., World Building, N. Y.

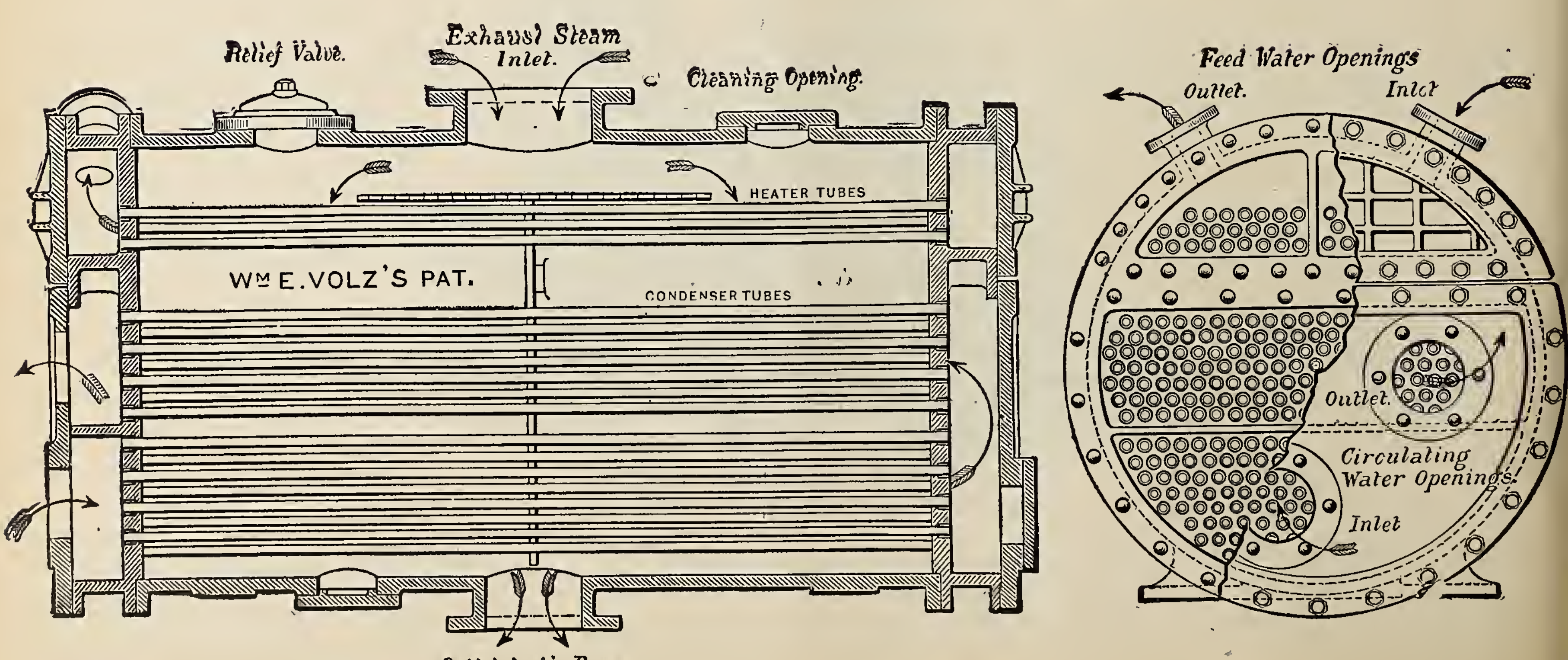
New Orleans, La.—The New Orleans Traction Company will shortly begin the erection of an electric power plant to supply its railway. M. Maury, president.



Improved Wheeler Admiralty Surface Condenser.



Rectangular Pattern Mounted Upon Air and Circulating Pumps.



Combined Surface Condenser and Feed-Water Heater.

WHEELER IMPROVED SURFACE CONDENSERS.

The Wheeler Condenser and Engineering Co., Nos. 39 and 41 Cortlandt street, New York, manufacture a fine line of condensers. Their improved Wheeler-Admiralty surface condenser has single instead of double tubes. Provision is made for expansion and contraction and the liability of leakage reduced to a minimum by a special system of jointing. One extremity of the tube is threaded and its end slotted; the other end is secured by a screw gland and packed with corset-lace packing.

The rectangular pattern is seen in sketch mounted upon air and circulating pumps. It is of the circular shell pattern, compact and complete in every respect. Leakage does not occur or the weakening of any part by changes in the metal.

Condensers have added a great deal to the engineering art. They have added life to the plant, and become the basis of a practical system of economy.

The Volz combined surface condenser and feed-water heater is an example of one of the best devices made. On board steam vessels and in electric light and power plants it is practically indispensable. The exhaust steam in this type comes into contact with the heater tubes and then with the condenser tubes, after which it flows to the air pump and then to the hot well tank.

The course of the steam is shown in the sketch. The shell is of cast iron with water chambers and tube-heads in composition casting. The feed is separated from the circulating water by division plates cast in, thus avoiding joints. The entire apparatus is excellently made from a scientific as well as a commercial standpoint.

Trolley Inroads.—During the past fiscal year the passenger earnings of the steam railroads of the United States decreased $33,103,000, while the freight earnings increased $30,502,000. It is asserted that a very large part of the decrease in passenger earnings is due to the competition of electric railways.

Vast Electrical Interests of the Country.—It is one instance of the progressiveness of the United States that there is more capital invested in the electrical industry here than in all the rest of the world. In round numbers, there is not less than $1,750,000,000 invested in the industry in this country, not including capital in ocean cables.—Philadelphia Record.

Note.—In our last issue's report of the meeting of the the Police and Fire Telegraph Superintendents, Mr. Clark was mentioned as the representative of Fire and Water. This was wrong. He was the representative of the Fireman's Herald.

The American Stoker Co., of Dayton, O., has recently perfected a steam motor which is applied to each stoker, thus making each machine independent. This renders the work of installation very simple. It also renders the stoker practicable for use under marine boilers.

This company is desirous of a general representation through engineering firms handling pumps, heaters and boiler room supplies, and invites correspondence from interested parties.

Hotel Monument, cor. 123d St. & Eighth Ave.,
John O'Neil, Prop.

Messrs. McLeod, Ward & Co.

Gentlemen:—In reply to your inquiry as to the working of the electrical plant installed by you in the Hotel Monument, I take great pleasure in stating that the same is entirely satisfactory, and neither the dynamo nor the wiring have given a particle of trouble since installed. And in conclusion will say, I am thoroughly pleased with the working of the plant. I remain,

Yours truly,
John O'Neil.

This plant consists of a White & Middleton gas engine and Dallett dynamo.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—ELECTRICITY PRODUCING MONSTROSITIES.

Quebec, Sept. 26, 1896.

Electrical Age Publishing Co.

Dear Sirs:—In a recent editorial you spoke of the effect of current on an organism. The current passed through an egg was strong enough to have killed the hen. When hatched the chicken was of monstrous growth—a departure from the normal. Can a current leave a germ with life and still kill that which developed from it? Yours faithfully, Jules Cremeau.

(A.)—It has been repeatedly shown that germs will withstand boiling water with impunity. If heat, which would quickly deprive a more highly developed being of life does not destroy the primitive form—the germ itself—the statement made should be acceptable. Even intense cold is resisted by certain germs, seeming to show that life persists with greater tenacity under abnormal conditions in the simpler than in the more highly organized forms of life.

(Q.)—TELEPHONE ACROSS THE OCEAN.

San Francisco, Sept. 22, 1896.

Dear Editor:—I am deeply interested in your journal, finding it the most instructive up-to-date electrical paper printed. I would like to use your Inquiry Column in asking whether it is not possible to telephone across the ocean? The cable is of copper inside and I see no objection to its immediate use for that purpose. Kindly excuse a layman's curiosity. Yours very truly,

Edward Winter.

(A.)—One of the most noteworthy problems of the day is that of ocean telephony. The difficulty is due to the retardation of signals in the cable. The cable acts like a large tank from which, in order to get water, we must make it overflow. It must be charged with electricity from end to end before a signal is received—before the electrical drippings become evident. The minute currents issuing from a telephone would be completely lost in a submarine cable. The electrical problem is to reduce the capacity of the cable.

(Q.)—SIGNALLING THROUGH THE EARTH WITHOUT WIRES.

Philadelphia, Sept. 24, 1896.

Editor Electrical Age.

Dear Sir:—I have been hearing very much of late of the possibility of signalling through the earth without wires. Is this a "fake" or has it any scientific basis? The earth is so large that I thought it a difficult thing to disturb its natural equipoise. Yours respectfully,

Oliver C. Madden.

(A.)—There is a scientific basis for this statement. If the charge residing in the earth could be disturbed at will, a properly constructed piece of apparatus would indicate such changes. The production of definite disturbances in a systematic manner would enable the exchange of signals to take place between places that were the very antipodes of each other. The earth itself would be a charged sphere, the variation of which would be felt in every portion of the globe. The idea is far fetched, it is true, but not merely a dream.

(Q.)—METALS RELATIVELY + AND —.

St. Louis, Sept. 14, 1896.

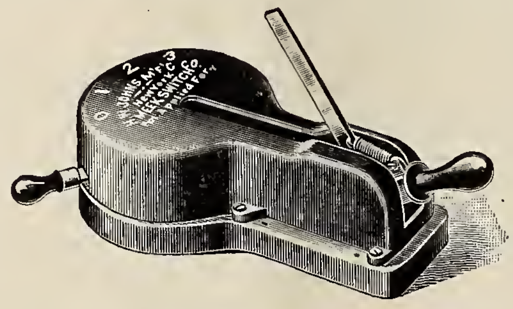
To the Editor:—If not too much trouble I would like to know why zinc and carbon are always negative and positive, or other materials, the same in a battery?

Yours respectfully,
Laurence Moth.

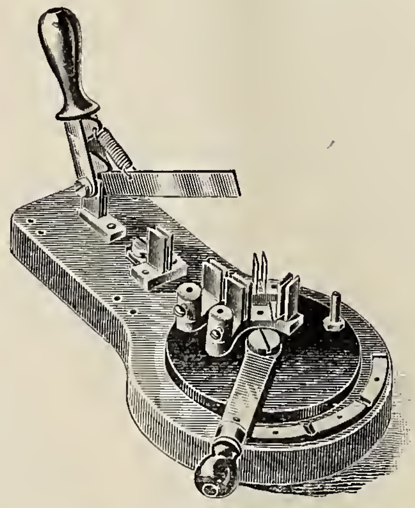
(A.)—Zinc and carbon are not always negative and positive. Iron is negative towards zinc, but positive towards copper. Copper is negative to zinc or iron, but

positive to silver, platinum, etc. When zinc is dissolved, it gives its + electricity to the carbon. Under certain conditions the reverse may occur. There is no relationship that cannot be set aside.

"H. W. J." Electric Car Heater Company of No. 87 Maiden lane, New York, in constructing their heater have made it their object to secure simplicity, effectiveness, durability and economy. The resistance wire is not liable to become oxidized, as it is effectually protected from the atmosphere by being covered with asbestos, which forms a complete electrical insulation. The wire is first wound with asbestos thread, and then woven into cloth with an asbestos warp.



Heat Regulator, Closed.



Heat Regulator, Open.

A piece of cloth containing a certain quantity of wire is fastened by fireproof insulating cement to a sheet of asbestos mill board, which forms its support. The whole is then enclosed in a neat covering of perforated steel plate, as shown in the illustration. The steel covering is japanned with an insulating compound.

Section Exposed.

Several important improvements over others are attained in this car heater; as the insulated wire folds back upon itself, forming a U-shaped loop, there are no coils to short-circuit when expanded by heat, nor to break when contracted by cold.

There is a free circulation of air through and under the perforated steel plate, which is fixed so that the back of the heater is about half an inch in front of the panels below the seat.

As these heaters are attached to a car by screws only, there is no mutilation of the woodwork.

Usually six heaters are placed on each side of the car, extending from end to end, thus insuring a uniform temperature throughout, without requiring an excessively high local temperature in the heaters themselves. The heaters are controlled by a patented knife switch, which can be adjusted to give three different degrees of heat.

At No. 1 the lowest temperature is generated with from $2\frac{1}{2}$ to 3 amperes; at No. 2 a medium temperature is produced with from 5 to 6 amperes; and at No. 3 a maximum with an average of 8 amperes.

Great simplicity is secured by this method, making it practical for any intelligent person to properly regulate the heat.

—The Eureka Tempered Copper Co. have reorganized, and the New York office will not be changed. Mr. Harry M. Shaw, No. 126 Liberty street, N. Y., still has charge of it. He is an exceptionally good salesman, vigorous, full of business and willing. His conscientiousness makes him a valuable man to those whose interests he represents.

—The Riker Electric Carriage covered a space of one mile in two minutes and thirteen seconds. This is the best ever made by any horseless carriage and may be considered the world record.

—The Snow Steam Pump Works of Buffalo, N. Y., through their N. Y. office, secured an order for the steam pumps of the new Syracuse Street Railway Power Plant, N. Y.

—James D. Reid, United States Consul at Dumferline, Scotland, was a passenger on board the American liner "St. Paul," which entered port a short time ago. His arrival was hailed by the entire telegraphic fraternity. Mr. Reid is the patriarch of telegraphy, having been a co-worker with Prof. Morse, the father of the science. The American ensign was raised and dipped in his honor, and the words "Glad to see you" were signalled to him as a greeting from all his friends when the "St. Paul" passed Sandy Hook.

Strength of Electric Welds.—It is generally recognized that electrical welding results in producing a practically continuous piece, the strength of the weld being equal to or greater than that of other portions of the welded body. An example of this is seen in some published tests conducted in England as to the tensile strength and absolute soundness of flanges welded electrically. An eight-inch iron pipe one-quarter inch thick, with flanges welded electrically, broke in the body of the pipe at 88 tons, and a similar pipe of steel broke in the welded part of the flanges at 101 tons.

CANADIAN LETTER.

Toronto, Ont.—A Toronto-Hamilton trolley line is among the possibilities of the future.

Hamilton, Ont.—The new radial line from Hamilton to Ancaster has been granted a free right of way through the latter municipality.

St. Thomas, Ont.—Negotiations are pending for the sale of the St. Thomas Street Railway to a Cleveland company.

Perth, Ont.—The time for beginning the construction of the Perth and Lanark Electric Railway has been extended one year by the Perth town council, provided satisfactory guarantees of good faith are given on behalf of the company.

Meaford, Ont.—A by-law has been passed to authorize the Huron and Ontario Railway Company to construct, equip and maintain a line of railway through the various streets within the limits of the corporation of Meaford.

Quebec, Que.—A company of Quebec capitalists is in the process of formation to take over the franchise of Mr. Beemer and construct the electric railway. The capital necessary for this purpose for the equipment of the road is estimated by M. Badger, who has charge of obtaining subscriptions, at $400,000, and amongst those who have already subscribed are the following: E. J. Price, $25,000; E. E. Webb, $20,000; T. H. Dunn, $20,000; A. Breakey, $20,000; F. W. Ross, $20,000; A. Thompson, $10,000; E. M. Methot, $10,000; E. Sharples, $10,000; G. T. Davie, $10,000. It is the intention of the promoters to put between 400 and 500 men on the work at once, to equip and put in operation the Lower Town Section as far as St. Valier tollgate this fall, and to keep the cars running during the winter.

The line from Champlain street along Dalhousie street is the section of the Quebec Street Railway which will first be constructed. The rails are now on their way to Canada.

London, Ont.—The local street railway company are gainers to the extent of from $12,000 to $15,000, by the decision of the Privy Council of England allowing the Toronto Street Railway Company a remission of the duties paid on imported steel rails.

Montreal, Que.—Another step towards the completion of the work of harnessing the Lachine Rapids and bringing cheap light and cheap power into the city, took place on Saturday, Sept. 12, when about eight hundred most prominent citizens of Montreal and vicinity attended the ceremony of laying the corner-stone of the main dam and power house of the Lachine Hydraulic and Land Company. The works had been gaily decorated for the occasion. The band of the Sixth Fusileers was in attendance. Among those present were Messrs. E. McQuirde, New York; J. B. Fraser, Ottawa; Dr. Ami, Ottawa; Jas. Davis Cornwall, Seybold, Ottawa; John Yes, Prince Edward Island; Messrs. Coleman, New York, and others. Addresses were delivered by Messrs. W. McLea Walbank, C. E.; G. B. Burland, president of the company; Sir William Hingston, M. D.; John Crawford, Hon. Louis Beaubien and W. McKay.

Huntsville, Ont.—The City Council has passed a by-law in favor of putting in an electric lighting plant.

Sistowel, Ont.—Tenders will be asked shortly for installing an electric light plant in this town.

Niagara Falls.—The Niagara Falls Power Company have contracted for additions to their premises and plant to cost $3,000,000, for the purpose of furnishing power to Buffalo, N. Y.

Windsor, Ont.—Mr. Geo. G. Goodman has secured the contract for the construction of the new street railway barns and power house on London street. The building is to be of brick, 165 x 65 feet. J. Alcide Chausse.

POSSIBLE CONTRACTS.

Philadelphia, Pa.—Plans are being prepared by Hales & Ballinger for a five-story brick and iron factory, to be erected at 2600 Cumberland street, for R. C. Remmey & Son.——George Hurst, Germantown, has received the contract for the alteration and addition to the residence of J. A. Patterson, Germantown. The following are to be included in the general contract: Electrical work, steam heating, cement work, etc.

New Blumsfield, Pa.—Plans have been accepted by the Rev. George Barnhart for a new church. Cost about $10,000, and will include electrical work, steam heating, etc.

Philadelphia, Pa.—Architect R.G. Kennedy, 423 Chestnut street, is receiving bids for a three-story residence. The cost of this dwelling will be about $10,000, including all sub-contracts, such as hot water heating, electrical work, plumbing, etc.——Plans were presented to the building inspectors for a five-story factory building, which is to be built at Randolph and Jefferson streets for J. H. Bird. The building is to be 201 x 73 feet. Architect, Joseph Bird, Trenton, N. J.

Providence, R. I.—A new business block is to be erected by S. & B. Lederer on Mathewson street. It will possibly be twelve stories high and have iron, glass and terra-cotta front and all modern improvements.

Cleveland, O.—Sealed proposals will be received at this office up to noon of Monday, Oct. 26, 1896, for furnishing the materials and performing the labor necessary for the erection of an administration building. Proposals will be taken for the whole or any part of the work, and to be for excavation, foundation, masonry and brick work, cut stone work, wrought and cast iron work, roofing and sheet metal work, carpenter work, plastering, plumbing and gas fitting, electric light wiring, painting and glazing, marble and tile work, cement paving, boilers and steam heating plant. Drawings and specifications can be seen at the office of Samuel Hannaford & Sons, Hulbert block, Cincinnati, O., and at the office of the undersigned. By order of the board of trustees. J. M. Welch, chairman Building Committee, Athens, O.

Crescent City, Fla.—An electric light plant is being talked of in this city.

Deland, Fla.—A franchise has been granted by the city council for an electric railway, which will include the erection of an electric power plant. Address F. C. Band.

Fernandina, Fla.—The city council committee is having estimates for an electric light plant taken. Address the mayor.

Atlanta, Ga.—Bids are wanted at once and contracts will be awarded within sixty days for a new city jail, to cost about $175,000. Address Forrest Adair, commissioner.

NEW CORPORATIONS.

Albany, N. Y.—The Clinton Mills Power Company, of Clinton Mills, Otsego County, has been organized by Geo. Brooks, Geo. M. Jervis, and E. V. Adams, of Cooperstown. Capital stock, $10,000.

New Haven, Conn.—The Franklin Telephone Company has been organized to construct and operate telephone lines. Capital stock, $2,500. The subscribers to the stock are Geo. M. Griswold, John J. Hogan, Milton W. Marble, and Paul W. Harrison, of New Haven, and George W. Coy, of Milford.

Orange, Va.—The Orange Telephone Company has been incorporated. Geo. S. Shackleford, president, and W. C. Crittenden, manager. A system will be constructed at once.

Oswego, N. Y.—The Empire State Telephone Company has asked for permission to erect poles within the city limits on the west side of the river.

Baltimore, Md.—A charter has been granted to the Orange Telephone Company. A line will be constructed from Orange to Fredericksburg in the near future.

Duluth, Minn.—The Duluth Telephone Company is negotiating with Superior to form a new company and get a new franchise.

Kansas City, Mo.—The Standard Telephone Company, represented by D. A. Williams and C. H. Nearing, have asked for a franchise for constructing a system.

—The Nassau Electric Mfg. Co., Nos. 127 and 131 25th street, Brooklyn, N. Y., has just completed a new and handsome switchboard for the Star Theatre, Brooklyn. They report that business is rushing.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued August 25, 1896.

566,288. Ring Armature. Francis B. Badt and Oliver S. Lyford, Jr., Chicago, Ill. Filed January 15, 1896.

566,298. Facsimile Telegraphy. Harry W. C. Cox and Richard J. Crowley, London, England. Filed June 19, 1895.

566,334. Apparatus for Registering the Number of Telephonic Conversations. August Munch, Charlottenburg, Germany. Filed October 25, 1896.

566,341. Electric Heater. Herbert O. Rockwell, St. Louis, Mo. Filed February 8, 1896.

566,345. Trolley Support for Electric Railways. Sidney H. Short, Cleveland, Ohio. Filed April 20, 1896.

566,366. Brush Holder for Dynamo-electric Machines. Clinton E. Woods, Chicago, Ill. Filed January 15, 1896.

566,376. Trolley Wire Hanger. William Cooper, Schenectady, N. Y. Filed September 23, 1895.

566,397. Electric Railway Conduit. William S. Hull, Dallas, Tex. Filed February 28, 1796.

566,398. Mechanism for Operating Car Couplings. John E. H. Hyde, New York, N. Y. Filed December 18, 1895.

566,400. Motor Truck Gearing. Charles H. Johnson, Youngstown, Ohio. Filed December 24, 1892.

566,416. Telephonic Apparatus. Carl J. Schwarze, Adrian, Mich. Filed February 11, 1896.

566,426. System of Control for Electric Motors. Elmer A. Sperry, Cleveland, Ohio. Filed February 16, 1895.

566,468. Insulator Support. James B. Oliver, Shields Station, Pa. Filed December 30, 1895.

566,503. Automatic Signaling. John P. Culgan, Swissvale, Pa. Filed March 18, 1896.

566,507. Conduit Outlet Insulator. Frederick W. Erickson, Revere, Mass. Filed June 3, 1896.

566,531. Method of Making Secondary or Storage Battery Plates. Wilhelm Petschel, Berlin, Germany. Filed January 13, 1896. Patented in Belgium November 9, 1895.

566,532. Electric Despatch System. Charles F. Pike, Philadelphia, Pa. Filed May 31, 1895.

566,537. Electrical Hammering Machine. Thomas C. Robinson, Boston, Mass. Filed March 6, 1895.

566,541. Electric Switch and Signal Apparatus. Jens G. Schreuder, Wilkinsburg, Pa. Filed March 31, 1893.

566,542. Electric Railway. Courtland Skinner, Chicago, Ill. Filed March 7, 1895.

566,545. Electric Heating Apparatus. Richard A. L. Snyder and August F. Tinnerholm, Pittsburg, Pa. Filed July 23, 1895.

566,573. Electrical Indicating and Cut-out Apparatus for Portable or Other Electric Lamps. Robert Hacking and George Brand, Nottingham, England. Filed January 13, 1896.

566,612. Alarm for Boilers. John O'Connor and Collatinus A. Turner, New York, N. Y. Filed March 20, 1896.

566,614. Tool for Twisting Electric Wire Sleeve Connections. Samuel Olsen, New York, N. Y. Filed April 17, 1896.

566,648. Telephone Exchange System and Switching Apparatus. Alfred R. Bennett, London, George J. Somerville, Heaton Chapel, and Robert McLean, Nottingham, England. Filed March 26, 1896.

566,652. Arc Lamp Hanger. Winfield S. Bosley, Chicago, Ill. Filed February 13, 1896.

566,673. Electrolytic Apparatus. Charles W. Fielding, London, England, and Louis B. Walker, Elizabeth, N. J. Filed May 11, 1896.

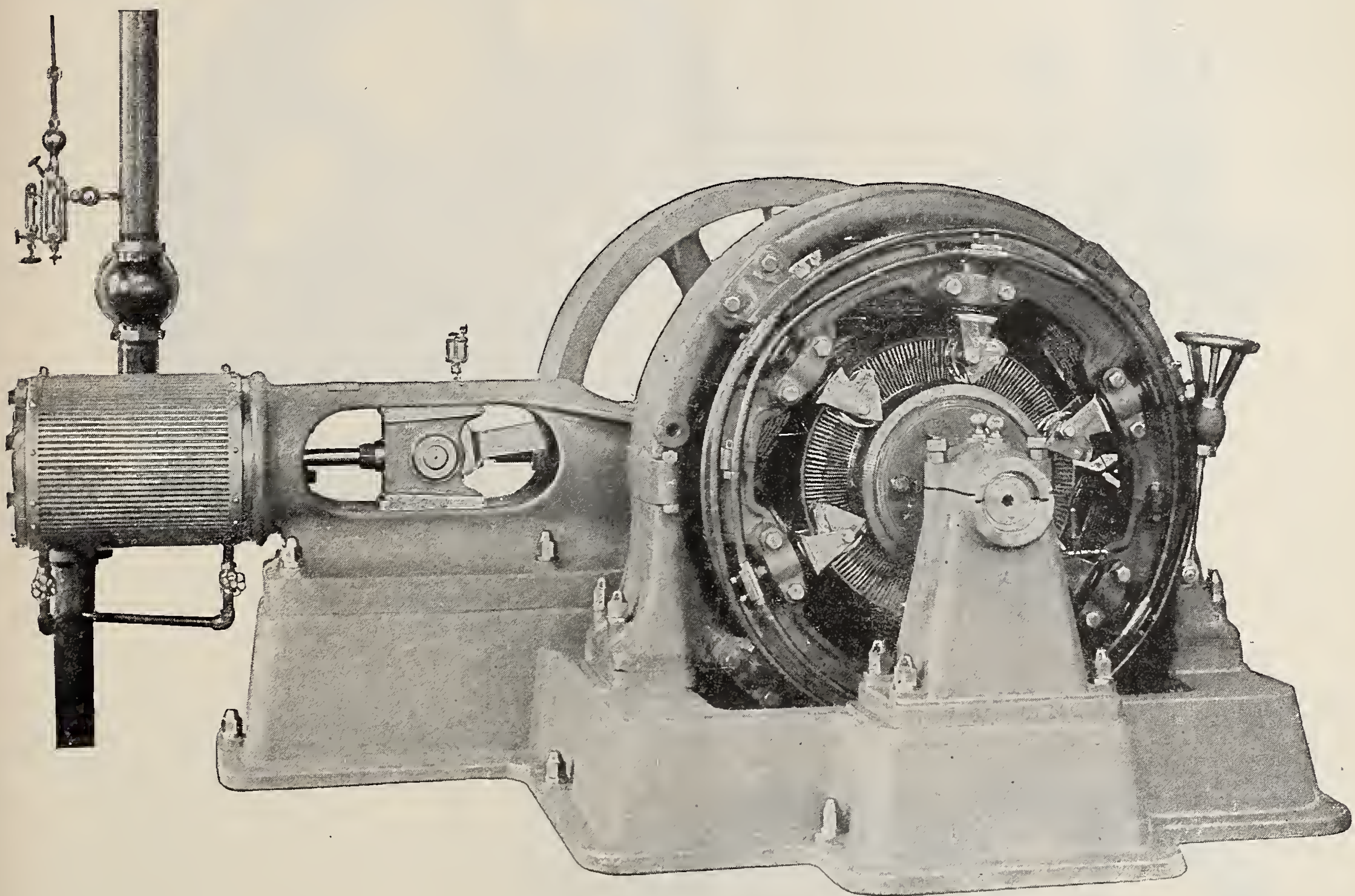
566,693. Electric Rheostat. Harry W. Leonard, New York, N. Y. Filed May 10, 1895.

566,697. Electric Cable Conductor and Sheave Wheel. James F. Place, Montclair, N. J. Filed April 12, 1894.

566,714. Switch for Condit System of Electric Railways. Julius L. Hornig, St. Louis, Mo. Filed August 26, 1895.

The Electrical Age.

Vol. XVIII., No. 15. NEW YORK, OCTOBER 10, 1896. Whole No. 491



Model Plant of Walker Electric Co.

DIRECT-CONNECTED PLANTS.

The use of direct-connected in place of belt-driven dynamos is constantly increasing. By belting, certain advantages were at one time gained which at present can hardly be considered of great importance.

Within the city, where space is very valuable from whatever standpoint it may be taken, a direct-connected plant frequently obtains precedence. There are reasons for this which appeal to the consumer as well as the technical student when fully understood. They may be taken in their order and considered from the various standpoints that practice dictates.

(1) Direct-connected plants occupy less floor space than those using belt or wire rope.

(2) The loss of power due to slip is reduced to a minimum.

(3) The wear and tear of belts, with their consequent expense, disappear from the books.

Since the advent and popularity of the multipolar dynamo the speed factor has been reduced considerably.

Due tó this lower speed, a certain amount of wear is entirely eliminated. This statement applies more directly to the dynamo than the engine.

In addition to these advantages, the later types of dynamos for direct connection have been built more substantially. Their life of active use has been increased, and the returns, therefore, for a given investment.

It is evident that direct-connected plants, or at least the pursuance of that practice, has exerted a beneficial influence upon dynamo construction, in the adoption of a given type for that purpose and the current expenses of the plant.

One of the sources of bother with belt-driven dynamos has been the constant tightening and loosening of the belt according to the load and weather. Without intending to refer again to the wear and tear of belts, it must be said that this alone is a fact having considerable weight in determining the choice. Many a dynamo tender will apply adhesive compounds to the belt when it behaves badly, rather choosing this temporary remedy to a further straining of either engine, dynamo and belt.

The limited space in the basement of many buildings has prevented the use of a long belt, thus adding a large factor of wasted power to the list of grievances.

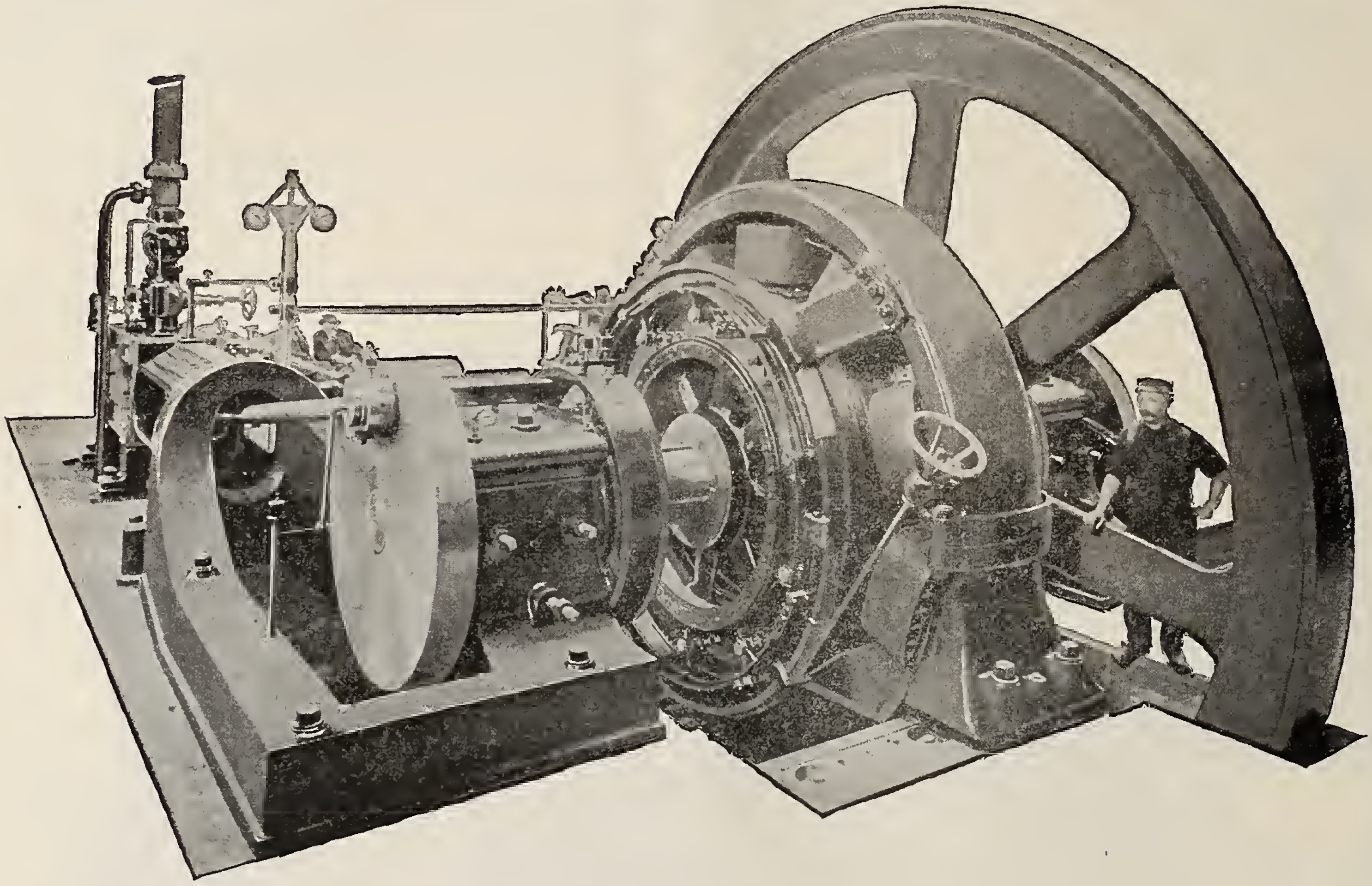
The dangers arising from high speed, due to imperfect filling of journals or irregular lubrication, deserve the proper notice.

In several large stations in this city, as well as many private plants, a bucketful of ice aside of the dynamo was a familiar sight, the bearings being piled heaping high with it.

The merest trifle of difference between the axis of the shaft and that of the journal, in spite of incessant oiling, will under the conditions of headlong speed and continued load develop a dangerous rise in temperature.

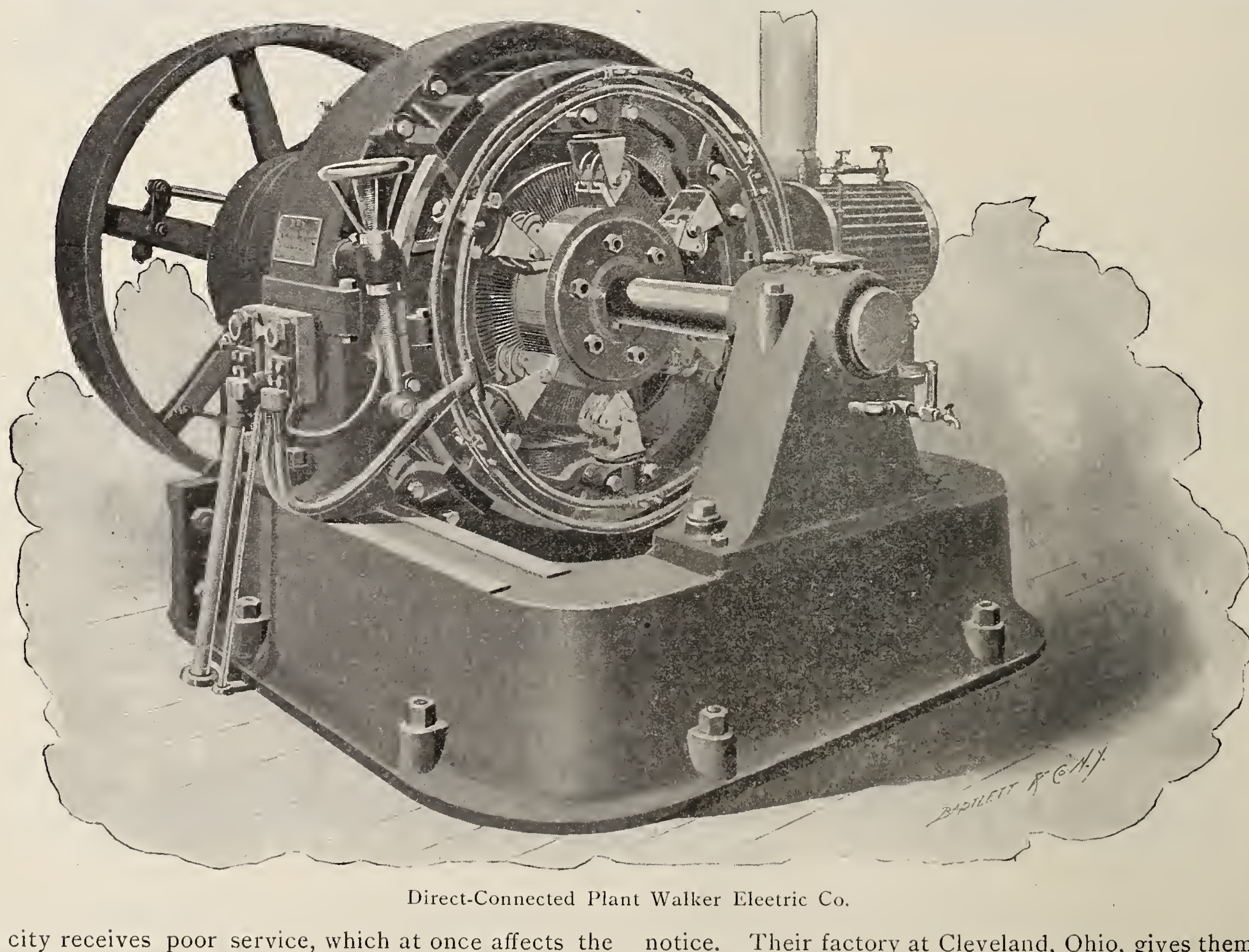
In large city plants the reveuue of a station is seriously affected at the year's end by a repetition of this fault.

The dynamo is eventually stopped; unless the station is well provided, the load falls on machines already hard pressed. The danger to those running is discovered by



Direct-Connected Plant Walker Electric Co.

the ruination of an armature, and it is possible that two dynamos may have to shut down. Otherwise a section of



Direct-Connected Plant Walker Eleetric Co.

the city receives poor service, which at once affects the company's receipts. A lower speed is at once advisable, from the double standpoint of station economy and efficient service.

Of the many direct-connected plants that do effective work in the United States the Walker Co.'s installations, as illustrated on these pages, deserves fit notice. Their factory at Cleveland, Ohio, gives them the greatest facilities for turning out direct-connected plants

of the most perfect design and regulation. In answering to the statements made in any case for or against direct-connected plants, none are better prepared to speak than those whose experience makes their opinion valuable.

The gradual spread of such plants about this and other large cities speaks well of the saving and satisfaction their use engenders.

ROENTGEN RAY APPARATUS.

The Edison Decorative and Miniature Lamp Department of the General Electric Co. of Harrison, N. J., have placed upon the market a complete set of Roentgen ray apparatus. The practical value of this discovery is made use of by means of improved apparatus of the most satisfactory type. Some of it may be classified as follows:

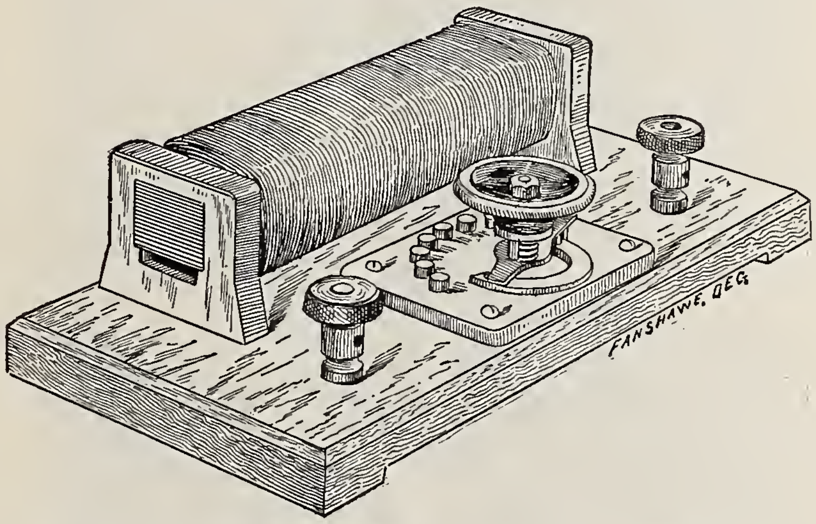
The Thomson Inductorium,
The Thomson Roentgen Ray Transformer,
The Roentgen Ray Static Machine,
Crookes Vacuum Tubes,
Fluoroscopes and Fluorescing material.

The Inductorium is made in several sizes. The sizes are called—Form F, class 3; Form D, class 6; Form E, class 12. The first two are generally illustrated in the sketches.

The Thomson Inductorium, Form F, class 3.—This is a small size apparatus of the induction-coil type. It is capable of giving a constant stream of three-inch working sparks. The materials and workmanship in this coil are of the highest grade, and the utmost care is exercised in the thorough insulation of all important parts. It is mounted upon a polished wooden base, in the interior of which is placed the condenser. This type is not furnished in oil, unless especially ordered that way, for which an extra charge would be made. The break is of the regular vibrator type, which is actuated by the current from the battery.

With this coil a considerable amount of X rays can be produced which will give excellent results in the fluoroscope. Good radiographs can also be made of hands, feet or limbs with this coil. The exposure would, of course, be necessarily longer than with a larger coil, but this 3-inch spark coil can be successfully used for ordinary purposes by physicians or amateur investigators. It is also especially recommended for use in small colleges, high schools and kindred institutions.

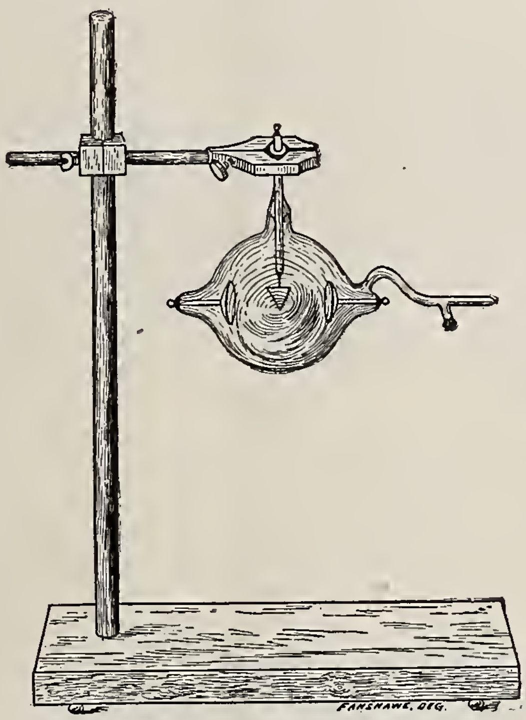
If used upon battery, two cells of storage battery will be sufficient to properly excite this coil. Should the purchaser not have facilities for charging storage batteries, and desire to use primary batteries, we would recommend the Edison-Lalande cell for the purpose, as it



Regulating Coil for Thomson Roentgen-Ray Transformer.

has a large ampere output and a minimum of polarization. Five cells of this type of battery will be sufficient to excite this coil, although as many as six may be used if desired.

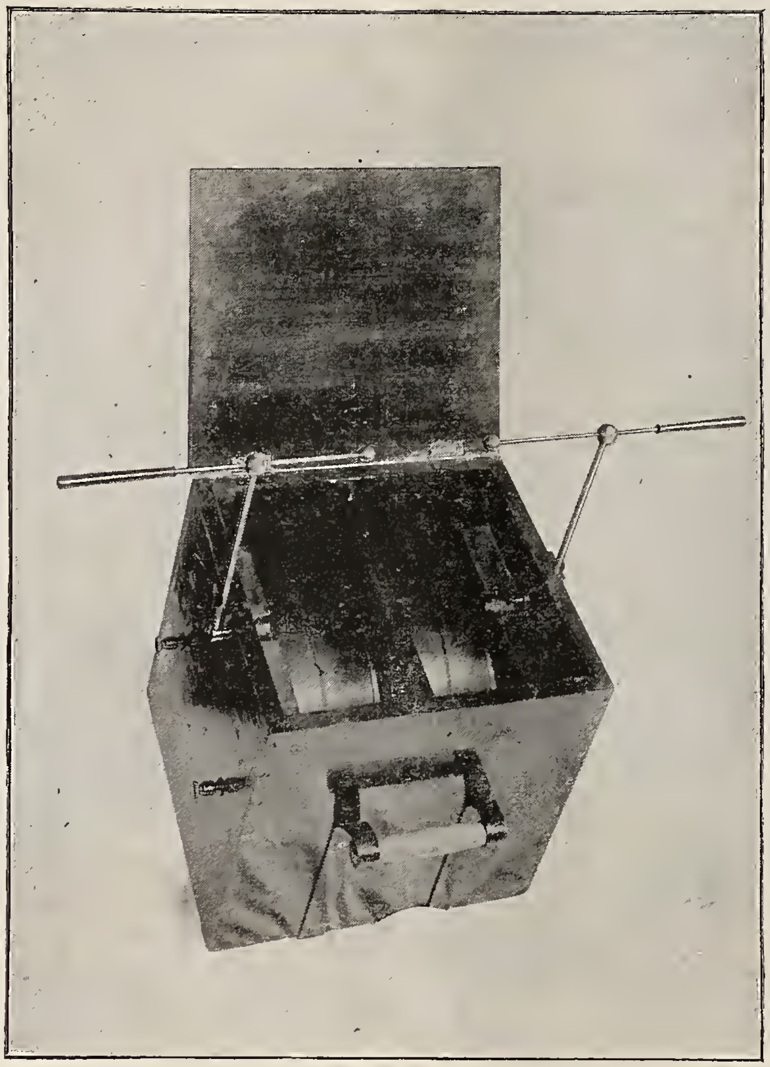
The Thomson Inductorium, Form D, class 6.—This is the medium size of Inductorium which is



Thomsons' Double-Focussing Tube.

suitable for almost all kinds of practical X-ray work. It will give a constant stream of working sparks six inches in length. This coil is carefully wound and insulated to a very high degree. In addition to the thorough insulation of the coil itself, the highest practical degree of insulation is further provided for by permanently arranging the coil in a substantial wooden box, which is intended to be filled with oil. This box is handsomely finished and is made with tight joints, so that the oil can-

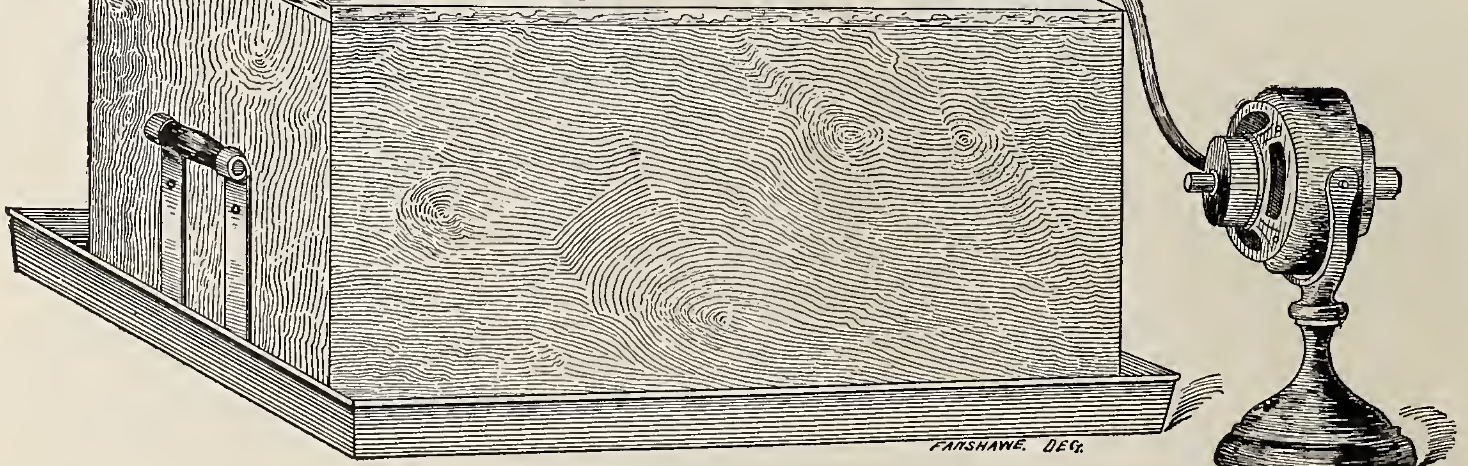
not drip therefrom. The terminals of the primary coil are brought to two binding-posts on the outside of the box. The connections with the secondary wires are made upon the outside of the box by means of two sockets, into



Thomson Inductorium Box.—Open.

which the standards connecting the discharge terminals are inserted.

The condenser and contact-breaker are entirely separate from the inductorium box. The condenser is contained in a substantial, well-finished box with two bind-



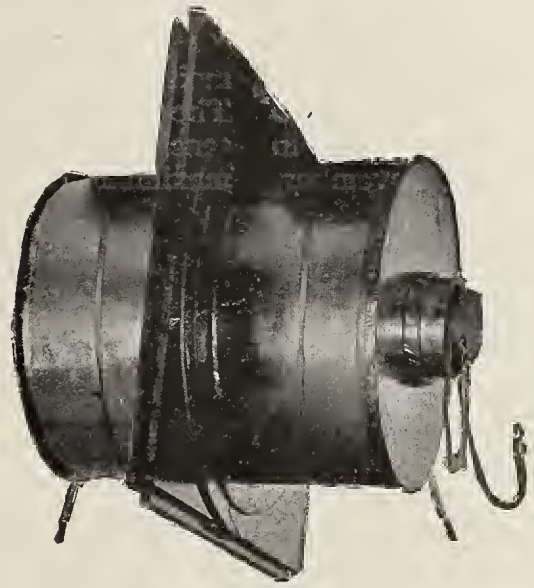
Thomson X-Ray Transformer.

ing-posts. The contact-breaker is a rotary one, operated by a small motor, and forms part of the equipment of the coil. This motor may be one to operate either upon a few cells of battery or upon an electric-light circuit, according to the wishes of the purchaser as expressed at the time of ordering. The contact-breaker itself is of the latest and most improved type, providing for the breaking of the circuit under water, in order to eliminate the sparking which invariably occurs when contact is broken in the air under ordinary conditions.

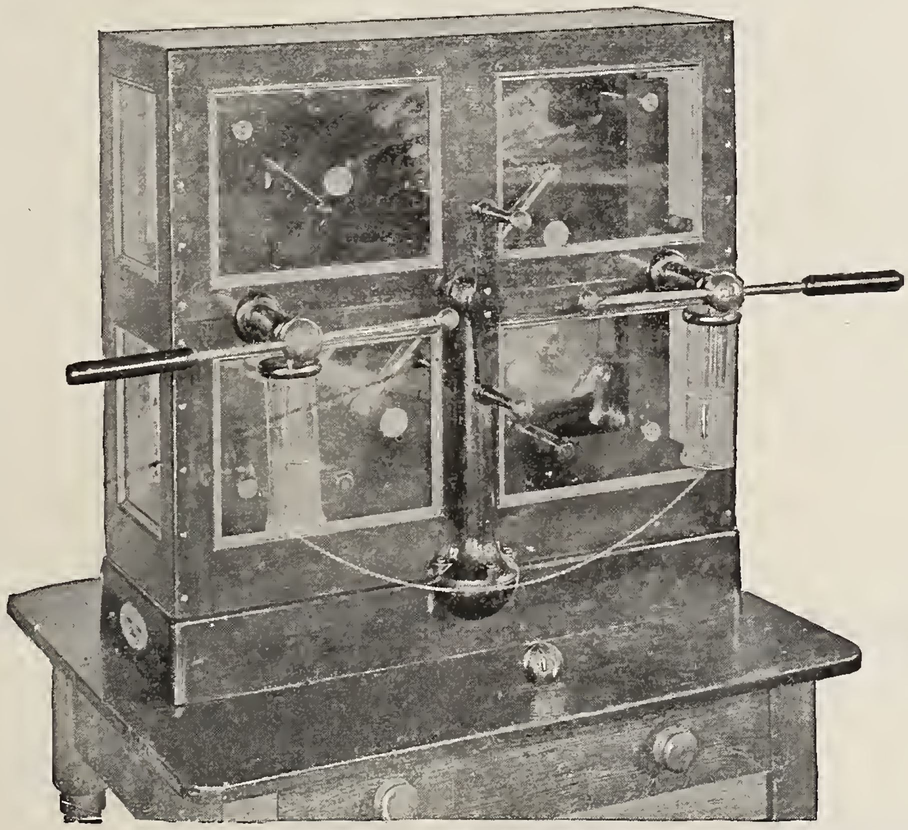
This size of Thomson inductorium is calculated to fulfil almost all requirements of physicians and surgeons for ordinary practice. In connection with either the Thomson double-focus tube or the single-focus tube, very clear and distinct fluoroscopic examinations can be made of the limbs and extremities, and to a considerable extent of the human trunk. Excellent radiographs can be made of the limbs and extremities in a few minutes, and of other parts of the body by longer exposure. This set is

recommended to physicians and surgeons, and also to investigators desiring to make other than amateur experiments.

Thomson Inductorium, Form E, Class 12.—This is the largest standard size of the Thomson inductorium furnished. It is suitable for all practical X-ray investigations, even of the most advanced kind. It has a capacity for furnishing a constant stream of working sparks twelve inches in length. Its construction is practically the same as that of the medium size Thomson inductorium giving a six-inch spark, but the insulation of the coil itself is of a much higher degree on account of the higher potential of the discharges given by this larger coil. It is also arranged in a substantial wooden box, made oil-tight and handsomely finished on the exterior.



Thomson Inductorium.—Before Mounting in Box.



Roentgen-Ray Static Machine.—Holtz-Toepler.

The Thomson Roentgen-ray transformer. — As the name would indicate, this is a set of exciting apparatus for use on alternating currents only. While the length of the working spark of this apparatus is only five inches, it is, on account of its high frequency and its practically unlimited supply, one of the most powerful sets of standard exciting apparatus that we furnish.

The Thompson Roentgen-ray transformer consists of a low-frequency transformer, a high-frequency transformer and a condenser built into a substantial wooden box, made to contain oil, and finished in a handsome manner. The discharge terminals and the spark gap are brought up on the outside and at the upper portion of the box, the spark gap being covered. In making the transformers and condensers, great attention is paid to insulation, and all parts are very thoroughly and heavily insulated. This insulation, together with that afforded by the oil with which the box is filled, affords unusual excellence and perfection in the insulating qualities of the set.

The only other accessories necessary to complete this set of exciting apparatus are (1) a smaller regulator, by means of which any necessary regulation is accomplished, and (2) a small motor air-blast connected with a jet placed immediately in the spark gap, by means of which the spark is ruptured with extreme rapidity and certainty.

The Thomson Roentgen-ray transformer is undoubtedly one of the most powerful forms of standard Roentgen-ray exciting apparatus that is made. With it, and a Thomson universal double focus tube, most elaborate and complete examinations of the opaque parts of the human body can be made, and even the movement of the heart can be discerned. The time of exposure for radiographs is reduced down to a minimum; in the case of hands or arms only a few seconds' exposure being necessary. It is admirably adapted for hospitals, for physicians and surgeons who can have the use of an alternating current. It is also well calculated for advanced work in universities and colleges.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 570.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

The glow lamp had previously been used for a long series of tests of many Hefner lamps, and so its intensity in terms of that unit was well known. From the table which is given it can be seen "that the Hefner lamp in March, April and May, also in October and November, had an intensity almost equal to 1, while during the months of June to September its intensity was on the average 2 per cent. smaller, and in the months of December, January and February it was larger by about the same amount. To be sure, the variations in the single months are not insignificant. For the month of May, for example, the variation was in the neighborhood of five per cent. The least intensity, 0.948, occurred in July, and the greatest, 1.033; in January and February, moreover, the variation of the light intensity during the year under consideration amounted to 8.5 per cent.

"Further, it is to be noticed that during this year the mean deviation of the intensity from that obtained from the previous calibration of the glow lamp was ± 1.78 per cent.

"The graphical representation as well as the computation by the method of least squares shows that the intensity, y, of the Hefner lamp can be represented with great accuracy as a linear function of the moisture of the air, x. We have, between the investigated values of hygrometric state of from three to 18 liters,

$$y = 1.049 - 0.0055\,x,$$

or

$$y = 1.049\,(1 - 0.0053\,x),$$

"The intensity decreases uniformly with increasing moisture by an amount equal to 0.55 per cent. per liter. The difference between the observed variations in intensity and those computed from the equation is, at its maximum, 0.9 per cent., while its mean value is ± 0.41 per cent. In the original definition of the light unit, the moisture of the air was not taken into consideration. Since the deviations which follow from this are in the mean ± 1.78 per cent., the original definition of the Hefner light is sufficient for almost all technical purposes. If one wishes a greater accuracy, some datum concerning the hygrometric state of the air must be inserted in the definition of the light unit. It would be necessary then to determine for what proportion of moisture the intensity of the Hefner lamp should be taken equal to 1. On practical grounds, it is advisable to select for this a mean value; accordingly, that hygrometric state was taken as normal which made the above meausurements give a value for the intensity of the glow lamp which was in exact accord with the previous extensive calibration of the same, namely, 8.8 liters per c. m. of dry air. The light unit designated by the Reichsanstalt in its official tests as the Hefner light is accordingly taken exactly; the intensity of the Hefner lamp, when the hygrometric state of the air is such that there are 8.8 liters of moisture per c. m. of dry air."

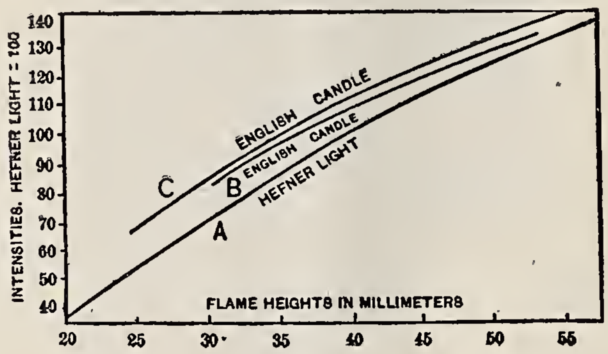


Fig. 14.

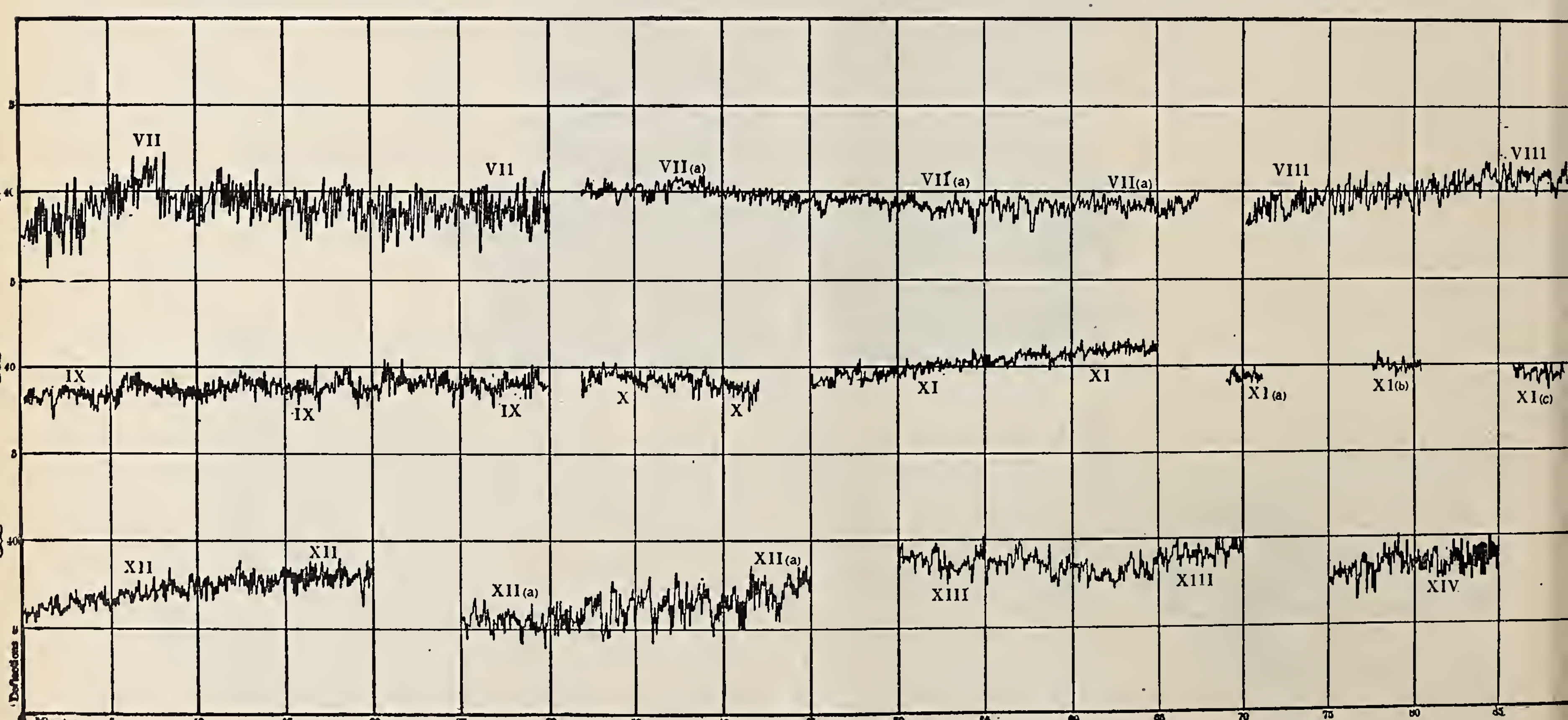


Fig. 15

The influence of pressure changes between the limits

(Continued on Page 588.)

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CONTENTS.

	PAGE
EDITORIALS	
Profit from Transmission Plants	587
Again the Carbon Battery	587
GENERAL SUBJECTS	
Standards of Light	586
Railway Installations	589
St. Louis Convention	592
Electricity Without Steam	587
TRADE NOTES	
Direct-Connected Plants	581
The Latest Pocket Faradic Battery	591
Elmer P. Morris	593
Combined Auger and Reamer	594
J Medical Battery	595
Possible Contracts	596
Roentgen-ray Apparatus	583
PATENTS	596
New Books	590
INQUIRY COLUMN	590

PROFIT FROM TRANSMISSION PLANTS.

The great transmission plants of the world are all alternating current equipments.

When we consider the fact that at one time doubt existed as to the best system to install, it seems strange that no large, continuous-current transmission plants were erected. One hundred miles north of Mexico City, in the town of Regla, State of Hidalgo, some heavy machinery is being erected for the transmission of power.

A power station containing five 400 H.-P. Pelton wheels, an aggregate of 2,000 H.-P., will be used for the driving of an equal number of 350-kilowatt General Electric three-phase alternators. A pressure of 10,000 volts will be sent over the line a distance of from 18 to 23 miles. The heavy stamp mills and ore crushers, pumps and other apparatus of the Real del Monte mines, one of the greatest in the world, will be supplied with power from this source. Over 8,000 men are employed in these immense works and 1,200 H.-P. will be consumed.

This is an example of two things—the use of natural facilities and the effects of a properly stimulated enterprise. The returns to the transmission company will be at the rate of $250 a year per horse-power delivered at the mines. We have railway kings and trolley kings; why should we not create a new municipality presided over by a transmission king?

AGAIN THE CARBON BATTERY.

Dr. Alfred Coehn, a celebrated scientist of Germany, makes this statement:

"The problem of the direct production of electricity from carbon would find its simplest solution if we could succeed in dissolving carbon in a fluid, just as we do metals."

He performed a series of experiments in which he obtained a coating of carbon on platinum plates. Developing his idea further he placed a plate of peroxide of lead opposite a carbon plate in a solution of sulphuric acid and obtained a current which was strong and constant and possessed a pressure of 1.93 volts.

By this combination carbon becomes *the soluble electrode*, and if a platinum plate be substituted for the carbon plate, or any other plate of an insoluble nature, the same result is only partly attainable; that is, the current rapidly weakens with an insoluble electrode.

It seems, therefore, that Dr. Coehn's labors have been fruitful. His conclusions were threefold:

(1.) By electrolysis carbon can be brought into solution.

(2.) From such a solution carbon may be separated as a cation.

(3.) An element may be formed of which carbon is the soluble electrode.

These important conclusions have been practically demonstrated as facts. The mass of sentiment brought to play upon the world's workers will have a fresh chance to dilate. Something has been actually accomplished of a most refreshing character. When Dr. Jacques produced his new coal battery, his own opinions were accepted without a doubt. We have found out since then that his cell was merely a thermopile of advanced construction. There is in reality no battery in existence that uses coal, coke, or carbon directly as one fuel electrode. The statements of Dr. Coehn again leads us to Dr. Oswaldt's proposition, which contains in substance the fundamental theory of a carbon battery; a cell in which carbon is consumed by oxygen and in which an electrolyte is used of an inconsumable character.

The interest this subject of carbon batteries has excited is increasing daily. The results so far have been of a purely scientific nature and, while pointing in the right direction, still lack that practical importance which leads at once to a world-wide recognition. Some of the ablest minds of the day are busy with the subject. Their discoveries are increasing our knowledge and leading us to expect that they will eventually unearth the hidden fact, the valuable principle which we hope will so greatly change our present source of light and power.

ELECTRICITY WITHOUT STEAM.

The most important recent developments in the scientific and industrial world were discussed last evening at the regular monthly meeting of the Franklin Institute. The latest prominent features of the scientific world is the Jacques carbon consuming battery, which produces electric energy, accounts of which were published in "The Record" some months ago. C. J. Reed gave an exhibition of the battery and a discussion of its action, together with a battery of his own invention, which he calls a "thermotropic battery." The Jacques battery, from apparently conclusive experiments shown last night, does not derive its electrical energy from the consumption of the carbon in the cell, as claimed by its inventor, but from the thermo-electric action of the combination, an iron pot containing cell and a rod of carbon. Mr. Reed showed that other substances might be substituted for the carbon and very much better results obtained, namely, copper, iron, steel, aluminum, and German silver. Dr. Jacques, however, Mr. Reed pointed out, has produced in reality an improved form of thermo-electric couple, many times as efficient as the old form, where two dissimilar metals were welded together, and only a very small fraction of a volt could be obtained with some of the combinations shown. The thermotropic battery consists in one form simply of any metallic wire, out at one point, and one of the ends thus made oxidized by heating in a flame for a minute. When this junction is heated by any source of heat electric currents are produced.—Philadelphia Record.

of 735 mm. and 775 mm. is shown to be a small one. If we call Δy the change in intensity corresponding to the barometric height b, we have:

$$\Delta y\ 0.0032 - 0.00011\ (b - 730) \text{ or}$$
$$\Delta y = 0.00011\ (b - 760).$$

This represents a variation of 0.1 per cent. per centimeter.

"To determine the influence of carbon dioxide, four series of observations have been carried out in the following way. Into the well-ventilated photometer room carbon dioxide was admitted, from a cylinder of the gas, and simultaneously with the photometric measurements the proportion of carbon dioxide was found, by Hempel's method, the moisture also being determined. If we represent the intensity by y' and the proportion of carbon dioxide in liters per c. meter of dry air by x', the following formula holds between 0.6 liter to 13.7 liters carbon dioxide — $y' = 1.022 - 0.0072\ x'$, in which the first constant on the right side of the equation refers to the intensity corresponding to the mean hygrometric state. Accordingly a variation in the amount of carbon dioxide by one liter causes a variation of the intensity by 0.0072 Hefner light; that is, by about 0.7 per cent."

"From a comparison of the formulæ for moisture and carbon dioxide we see that equal volumes of watery vapor and carbon dioxide lower the intensity in unequal ratios, which are to each other as 1 : 1.30. Therefore, volume for volume, the carbon dioxide influences the intensity to a greater degree than the watery vapor. Yet in reality the influence of the carbon dioxide is slight compared with the influence of the moisture, on account of its smaller quantity. In the freshly ventilated photometer room of the Reichsanstalt the proportion of carbon dioxide in the air varied between 0.62 and 0.93 liters; to this variation corresponds a change in intensity of 0.2 per cent., which is quite within the limits of the errors of observation."

"We see, therefore, that in a sufficiently large, well-ventilated photometer room the carbon dioxide does not exercise a damaging effect. Very small rooms, especially all inclosed photometric apparatus, may give rise to considerable errors, since the air in them is very soon vitiated to a marked degree by the addition of watery vapor and carbon dioxide, and by the removal of oxygen."

By other than German photometrists the Hefner light has been shown rather scant favor, the chief objection to it being that the flame is too red in color. Dibdin, indeed, made a rather extensive test of it, and found excellent results as far as steadiness goes, 90 per cent. of the tests being within one per cent. of the mean, and this in spite of the fact that he took the perhaps unwarrantable liberty of increasing the flame height to 51 mm., to make the intensity of the lamp equal to that of the British candle. The committee of the British Association found only four among 118 tests which deviated more than two per cent. from the mean.

The Dutch Commission, to which allusion has already been made, dismisses the Hefner light from consideration because of the instabability of the flame. They found the following values for deviation in intensity. For a lamp using the optical flame measure, the mean deviation was ± 0.71 per cent. and the maximum deviation ± 2.83 per cent.; for a lamp using a sight, the corresponding values were ± 1.08 per cent. and ± 4.32 per cent.

The bolometric investigation made by your committee upon the Hefner lamp is entirely corroborative of the previous testimony concerning the accuracy and steadiness of that standard. Typical results are given in fig. 15.

Curve VII. of this figure was taken when a window in the farthest corner of the room was raised about 2 cm. Curve VII. (a) was begun 25 minutes after the end of VII., the lamp having burned during the interval, and the flame having been readjusted in height. The window was closed. The marked difference between the two curves is due to the stoppage of this slight draft.

In taking the curve X., the sensitiveness was adjusted at 32.5, or about double the standard sensitiveness for the other tests of the candles and of the Hefner lamp. Then a computation was made, from the law of inverse squares, of the distance at which it would be necessary to place the lamp in order to produce the ordinary deflection.

The fact that the ordinates of this curve agree with those of the curves taken with a sensitiveness of 16.2, shows that the method of getting the sensitiveness by taking only first throws of the galvanometer needle was an allowable one. The length of time that the lamp had been burning, when curves VIII., XI., XII. and XIV. were begun, was 20 minutes or less. Each of these curves shows a gradual increase in the amount of radiation. This emphasizes the advisability of lighting the Hefner lamp a considerable time before it is to be used in photometric work.

TABLE VIII.

Amylacetate diluted with	Specific Gravity	Hourly Consump. in grams.	Deviation from normal rate.	Deviation from normal intensity.
			Per cent.	Per cent.
20 per cent. fusel oil.....	0.8645	9.96	+ 69	— 2.0
2 per cent. diamylen.....	0.8725	9.24	— 0.8	0
5 per cent. alcohol and 4 per cent. castor oil.....	0.8745	9.88	+ 6.0	Impossible to measure
10 per cent. isobutylacetate and 10 per cent. amyl-alcohol..........	0.869	9.28	— 0.4	+ 0.4
50 per cent. alcohol......	0.8408	12.92	+39.	+ 40.
Pure	0.8735	9.318		

TABLE IX.

	Lamp H II. mean Intensity.	Deviation from mean.	Percentage Deviation.	Mean Error of each group.
			Per cent.	Per cent.
	0.3524	— 0.26	— 0.73	± 0.35
	58	+ 0.11	+ 0.31	.38
	53	+ 0.06	+ 0.17	.23
	30	— 0.17	— 0.48	.44
	53	+ 0.06	+ 0.17	.32
	56	+ 0.09	+ 0.25	.44
	62	+ 0.15	+ 0.42	.60
	26	— 0.21	— 0.59	.54
	63	+ 0.16	+ 0.45	.27
Means. .	0.3547		± 0.40	± 0.40

(To be continued.)

The Real Source of Power.—It appears, also, that the ether is a reservoir of energy of various kinds—energy which has been computed to be not less than 500 horse-power per cubic inch. It is capable of transforming energy—the energy of matter—and it holds what it gets until it can act upon some other mass of common matter; but it is capable of exchanging energy with matter. Thus, when a body like a weight is raised, work is done upon the ether, and exists as a stress in it. When the weight falls, the ether gives it back. When a hot body loses its heat by the process called radiation, the ether receives the energy as wave-motion, and at once begins to distribute it. The energy is transformed from vibratory, in the molecules, to undulatory, in the ether, and, on meeting other molecules, is again transformed into heat. In like manner, with electric and magnetic action, there is an exchange of energy from matter to ether, or vice versa.

The above are tables VIII and IX referred to in last week's article (page 570).

RAILWAY INSTALLATIONS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

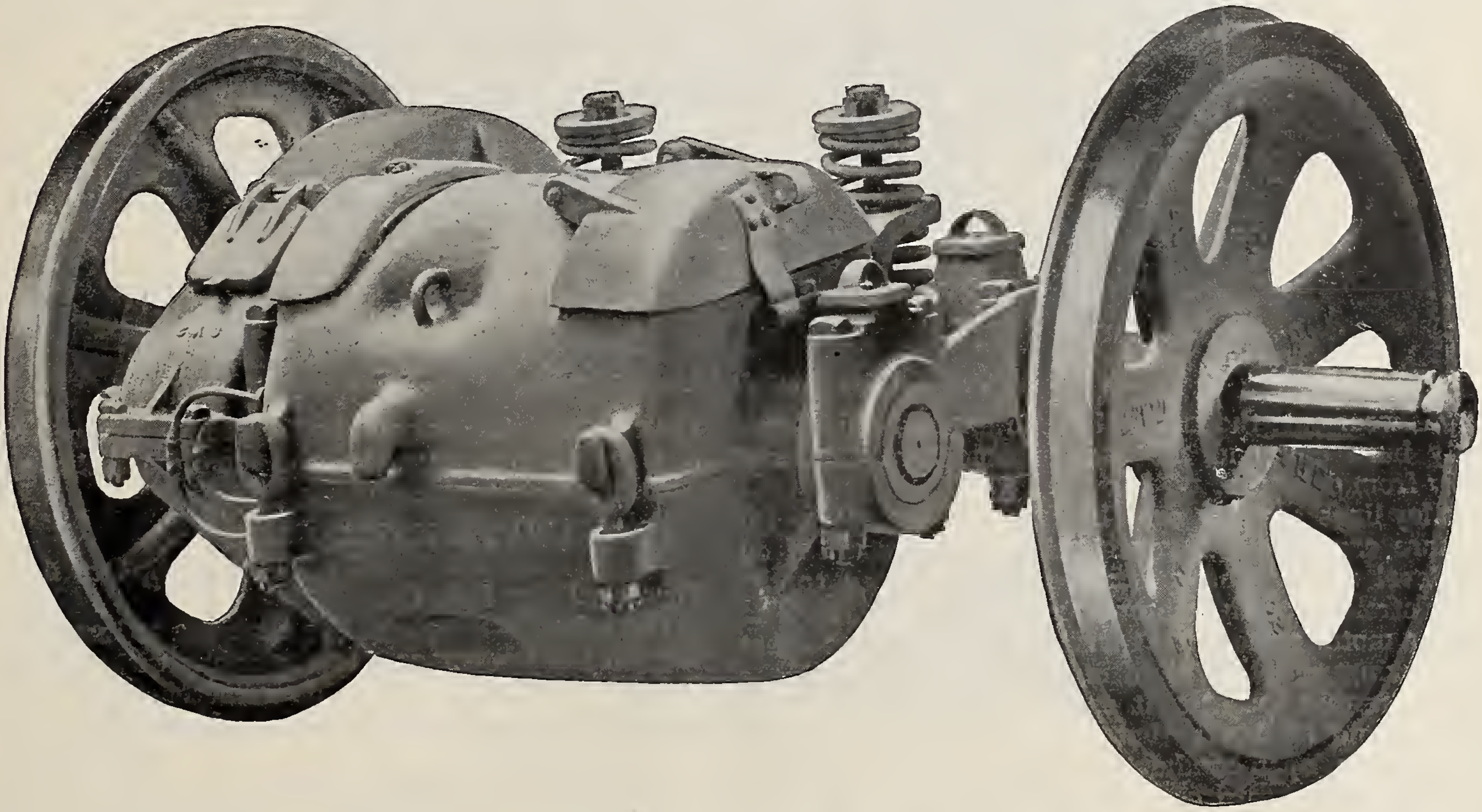
The use of motors for track service is limited to those of the series type. A series motor possesses advantages over the shunt that both experience and theory advocate. The current flowing through a series motor passes from brush to brush via armature and field. The speed and pull of the armature can be changed at will by varying the pressure applied to the armature and its current and field.

A trolley car is usually equipped with two motors. They are both series motors with commutated field coils. A small rheostat is in series with the pair. To vary the speed and pull of the car an automatic switching device called a controller is used.

Function of a Controller.—When the car is at rest the rheostat and both motors are in series. To start the car and put it through its different speeds, the controller, which consists of a cylindrical vertical commutator, is revolved. The general result is as follows:

(1) The rheostat and two motors in series.
(2) The two motors thrown in multiple.
(3) Subdivided fields thrown into multiple.

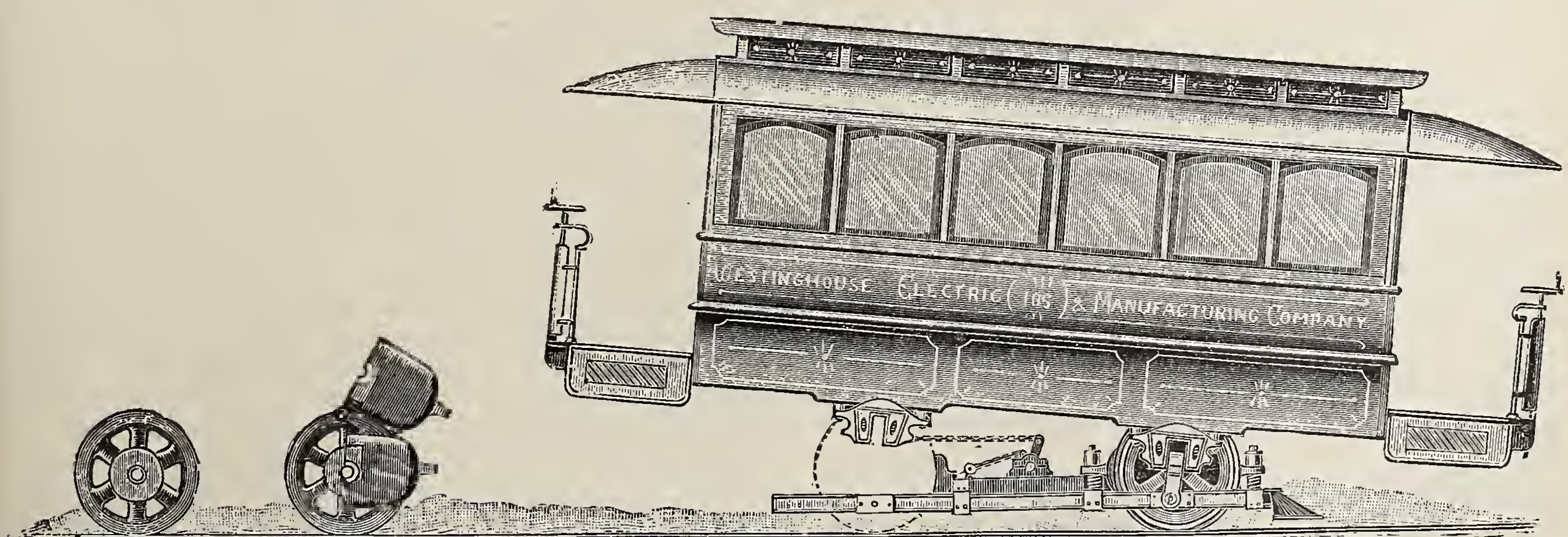
To each of these general processes there are subdivisions; that is, the rheostat contains steps which regulate to some extent—the motors may be thrown in multiple, or their fields and armatures separately, and in addition different combinations may be made of the commutated fields. The practical result of all these changes is to increase the current flowing through the motors by successive stages until the pressure and current is at a maximum.



Walker Railway Motor Mounted.

The pulling power of any armature depends upon the
(1) Current in the armature.
(2) Strength of field.

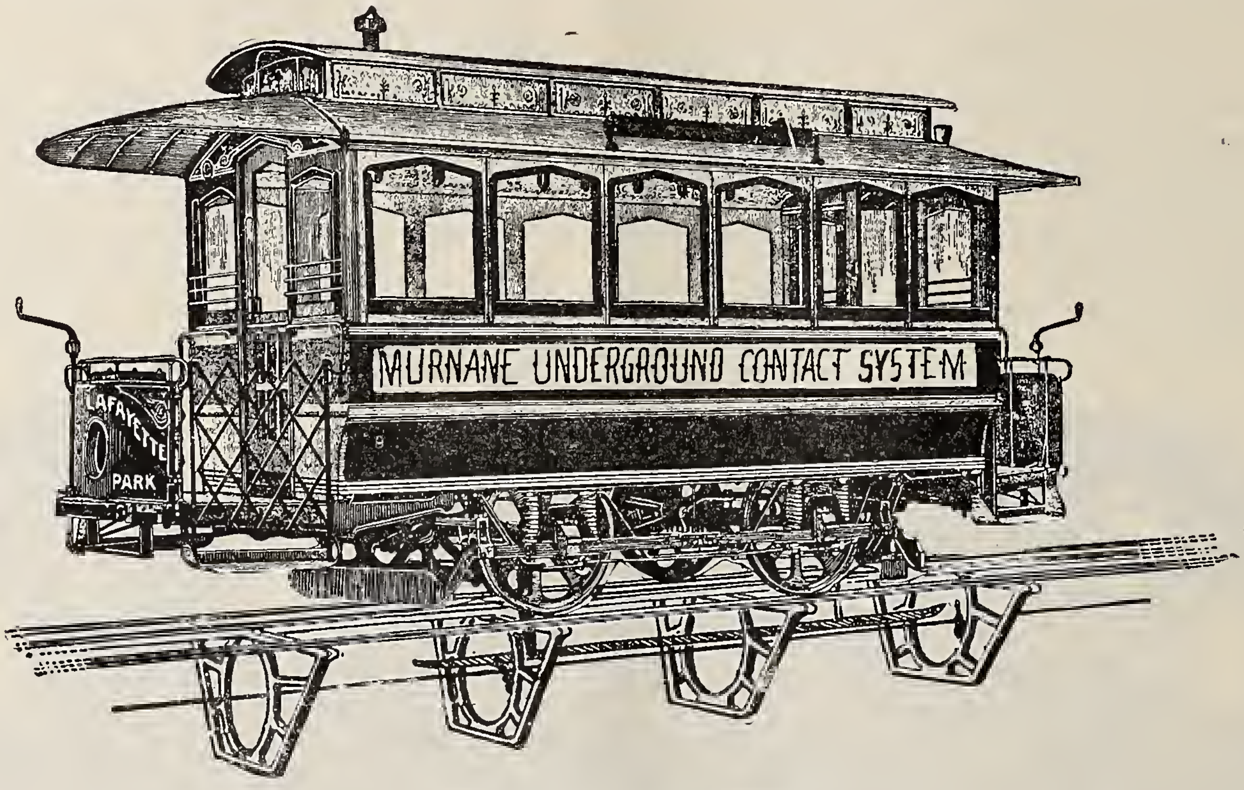
The series motor is naturally adapted by its construction to an easy system of regulation. Not only can the current be varied outside by having a rheostat in series with the motor, but the magnet coils can likewise act in this capacity by being subdivided. A series motor connected to a rheostat and having commutated or subdivided field coils can be regulated both in speed and power by these means.



Method of Removing Motor from Car.

The heaviness of motor cars has necessitated the use of strong steel rails and a secure bond. The cars used are not very different from the old horse-car style, except that they are better furnished, more capacious and in

every respect more comfortable. Both station, track, car and motors are a source of expense to the company. The station has machinery which depreciates; the track requires many repairs unless well put down, and even then the rails wear out; the motors have armatures which constantly burn out and the cars become scratched and shabby from daily use.



Open Conduit Electric System.

Trolley lines running over hilly ground are apt to incur more expense from repairs than those installed on more level road. The reason for this is traced to the greater strain upon the motors when climbing hills. The work the motor performs is divisible into two parts—that of advancing and that of lifting itself the height of the hill. In certain localities it seems evident that a cable system would be best; that is, a very hilly district. Block electric, open conduit and storage battery systems are occasionally heard of. In New York City, perhaps, the conduit system is receiving the best trial of all. Several of our largest railroads are about to permanently adopt electric cars for special purposes; the B. & O. being the most prominent of all.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—CHANGING VOLTAGE OF DYNAMO.

Philadelphia, Oct. 1, 1896.

Dear Sirs:—Having been required to change the pressure of my dynamo, I thought of asking your opinion of the best way. The armature runs at 1,000 revolutions and generates 110 volts. I want 100 volts, because of certain changes that have occurred in the use of the current. Kindly advise me. Yours truly,

Julius Bromberg.

(A.)—You can reduce the voltage by using a larger pulley or weakening your field. Use a pulley ten per cent. smaller in diameter, or a larger rheostat in the field.

(Q.)—USE OF STORAGE BATTERIES.

Montreal, Oct. 3, 1896.

Editor of Electrical Age.

Dear Sir:—As proprietor of a plant do you think I can extend my lighting by adding storage batteries to my station? If so, under what circumstances would their use be best? Yours respectfully,

Jacques Venier.

(A.)—The addition of storage batteries saves the expense of buying new machinery. If the additional cells cost more than the proposed machinery, the use of such cells is prohibitory. When the plant is lightly loaded the cells may be charged, and when the dynamo is working to its full capacity the charged cells may be thrown on.

(Q.)—ARC LIGHTING.

Pine Bush, Oct. 6, 1896.

Electrical Age Pub. Co.

Dear Sirs:—Which is the cheapest to install—a high tension arc system or a low pressure with incandescent lights? We are going to do something of the kind at once and need your advice. Yours truly,

Robert Sheean.

(A.)—If the lighting stretches over several miles, use high tension arc machines. If incandescent lighting is also required, you may either use an alternating-current dynamo for both purposes or install one extra and keep the systems apart.

NEW BOOK.

A volume entitled, "What is Electricity?" by John Trowbridge, S. D., published by D. Appleton & Co., has been received by us. It is the work of a careful reader and student. A deep appreciation of Maxwell's genius pervades the book. It is one of the most interesting pieces of electrical literature that can be found. The problems of the day which enter into the by-paths of this subject have been excellently treated. The author fully realizes that the strongest bond of relationship exists between the phenomena of light and electricity. A rich fund of valuable facts are contained within the book, so well stated that they are well within the compass of any interested reader. An original style and an exactitude of thought betrays itself on every page. The writer is an earnest as well as an able thinker. The coldness of scientific exposition is not there, while the fulness of truth weaves a web over the reflective mind. The volume is very creditable, deeply interesting and very original.

Electricity and Magnetism.—Volume II. of the Elements of Physics. By Edward L. Nichols and William S. Franklin. Price $1.50.

Among the subjects treated are the following, namely: Magnetism, Phenomena of Discharge, being a full account of the X-rays and Tesla's experiments; Thermo-electric currents, etc.

Mailed free on receipt of price.

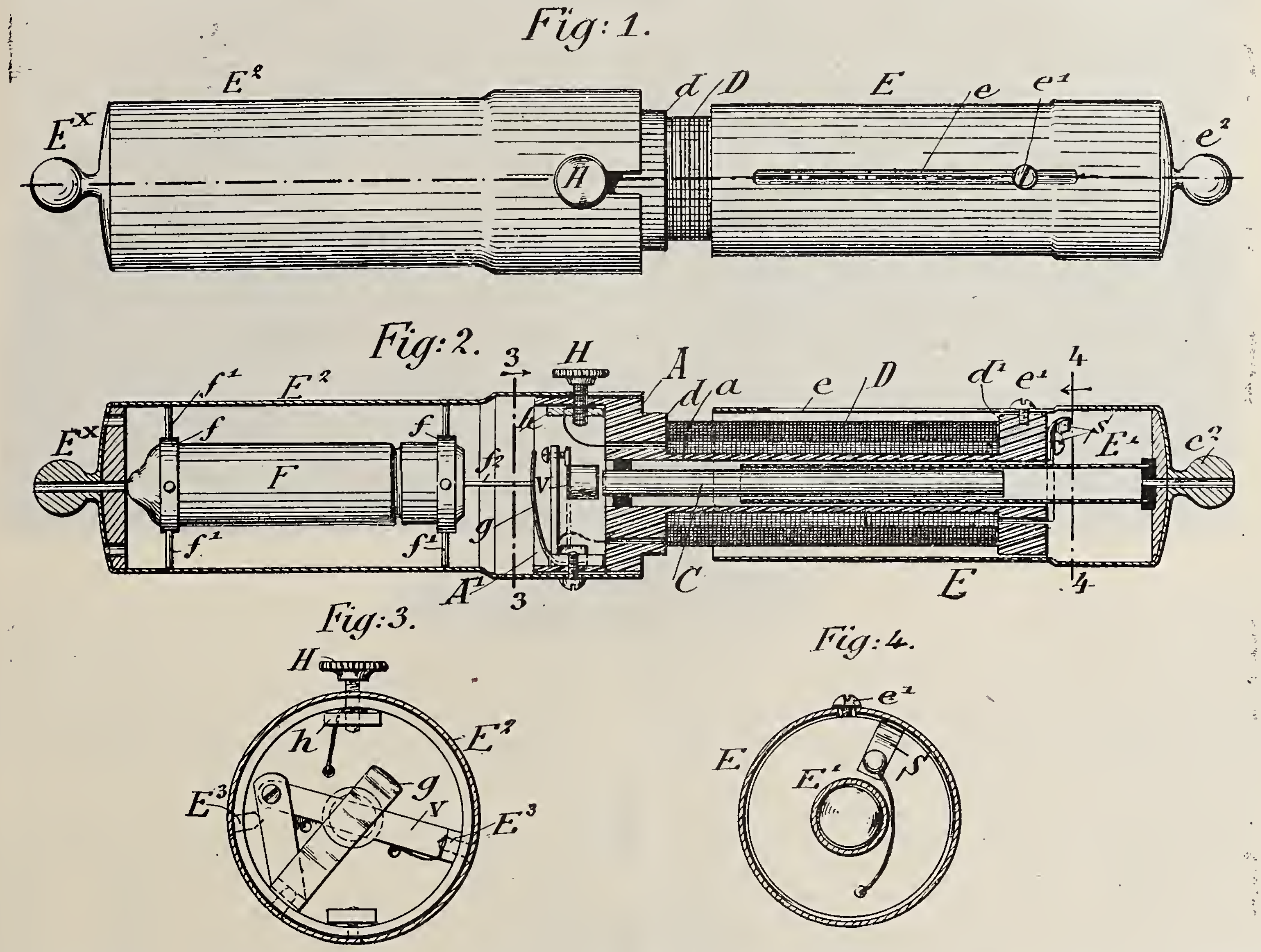
THE LATEST POCKET FARADIC BATTERY.

This invention relates to an improved portable faradic battery of that class known as "pocket batteries," for physicians' and surgeons' use. Generally these devices consist of a portable casing containing a galvanic battery and an induction-coil adapted for use with various electrodes for applying the induction currents to different parts of the human body.

The exterior casing of the battery forms the electrodes and serves as an inclosure for a so-called "dry-battery" and the induction-coil, so that the battery can either be held by both ends in the hands or held at one end in one hand, while the remaining part is applied by means of a sponge or other electrode to the part of the body to be treated, whereby the entire battery is made more compact and better adapted for external application; and the invention consists of a portable battery

Referring to the drawings, A represents the tubular central portion or main body of the improved portable faradic battery, which is made of hard rubber or other non-conductor of electricity and is reduced between its shouldered ends d, d^1. In the centre of the central tubular portion A the core, C, of the induction-coil is arranged, it being entirely surrounded by the central portion A, as shown in Fig. 2.

On the reduced portion, a, of the tubular portion surrounding the core, C, are arranged the usual primary and secondary windings of the induction-coil, D, which are retained between the shoulders, d, d^1, at the inner and outer ends of said tubular portion. The induction-coil is inclosed by a sliding sheet-metal casing, E, which is guided by a longitudinal slot therein on a headed screw or pin, e^1, attached to the shoulder, d^1, of the central portion, A. The end of the metallic sliding casing, E, is



which comprises a tubular central portion of non-conducting material, a sheet-metal casing fixed to said central portion and within which a suitable dry battery is placed, an induction-coil arranged on the core supported by the tubular central portion, a sliding casing inclosing said induction-coil and provided with a tubular portion extending over the core of the induction-coil and being guided on the central portion, contact devices between the battery and the induction-coil, a vibrator connected in the usual manner with said induction-coil, and a switch device by which the induction-currents are conducted to the fixed and sliding portions of the casing so that they can be used as electrodes, as will be hereinafter described.

In the accompanying drawings, Figure 1 represents a side elevation of the improved portable faradic battery. Fig. 2 is a longitudinal section of the same. Fig. 3 is a transverse section of line 3, 3, Fig. 2; and Fig. 4 is a transverse section on line 4, 4, of the same figure.

Similar letters of reference indicate corresponding parts.

made with a hollow knob, e^2, so as to form connection with the faradic battery. For ordinary purposes the sliding casing forms one electrode of the improved battery. At the interior of the sliding casing, E, is fixed a brass tube. E , which fits over the core, C, when inserted into the induction-coil and which serves as a damper to uncover the induction-coil more or less, so that induction-currents of increased or decreased strength are conducted through the body. The more the casing is drawn out the more the core is uncovered by the damper-tube and the greater will be the strength of the induction currents generated.

To the tubular central portion, A, is fixed a second casing, E^2, which is applied thereto by suitable fastening screws, E^3, and in which a suitable dry battery, F, of any approved construction is centred by arming it with circumferential bands, f, having radial steading-pins, f^3, as shown in fig. 2. The outer portion or body of the dry battery is connected by the bands and pins with the cas-

ing, E^2, while the carbon element thereof is connected by a centre pin, f^2, with a contact-spring, g, attached to the hollow portion, A, said contact-spring being electrically connected with the primary winding of the induction-coil, D. The outer end of the stationary casing, E^2, is likewise provided with a perforated knob, E^x, for inserting therein connecting wires of a suitable electrode in case the battery is to be used with separate electrodes.

The secondary winding is connected with metallic block h, attached to the interior hollow portion, A^1, of the tubular central portion, A; said metallic contact-block being in turn connected by a switch-screw, H, with the fixed casing, E^2. As the centre is turned the battery circuit is completed and the induction-coil operates in connection with the vibrator, V, in the usual manner; said vibrator being arranged in the hollow portion, A^1, of the tubular central portion, A, as shown in fig. 2, and formed of a vibrating contact-spring and a sto-screw, as is customary in induction-coils.

The connection of the secondary winding with the sliding casing or electrode is made by a contact-spring, S, that is connected with the secondary winding and applied to the non-conducting shoulder, d^1, of the central portion A, said spring being always in contact with the casing E, whether the same is in normal or drawn-out position. By drawing the casing, E, out more or less the induction current is increased, and can be regulated as required by adjusting the casing E on the induction-coil. By removing the casing E, sponges, brushes, or other electrodes can be applied to the induction-coil whenever special application to the body is made, the faradic battery being then held by the casing E^2, which forms the other electrode.

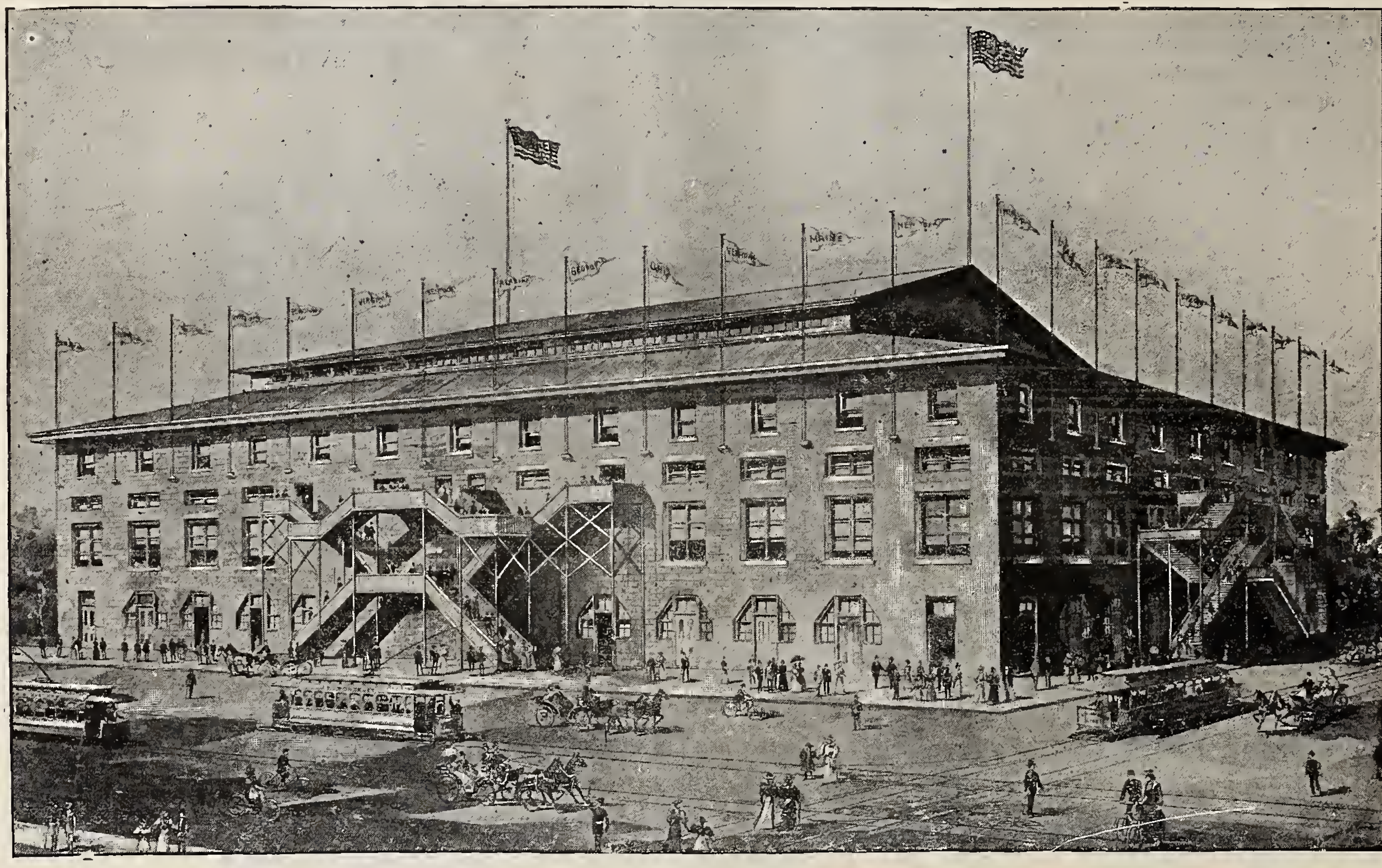
The advantages of the improved faradic or pocket battery are, first, that the same can be made in sizes which will answer all the requirements of the larger portable induction-coils heretofore used; secondly, that by using a dry battery no spilling of acid is caused, while the new battery can be replaced with the greatest ease at any time when the old battery has run out, and, thirdly, the battery is quickly put into action so as to be quickly applied to any part of the body.

LEO T. LEVY, Patentee,
No. 169 West 57th Street, N. Y.

ST. LOUIS CONVENTION.

Office of the American Street Railway Association, 621 Broadway, New York, September 28, 1896.

Arrangements have been made for a special train via New York Central and Hudson River Railroad and connections for the accommodation of delegates and others



The Convention Hall in St. Louis, Mo.

attending the St. Louis Convention of the American Street Railway Association. The convention will open Tuesday, October 20, at 10 A. M. The special train will leave the Grand Central Station, 42d street, New York, Sunday, October 18, at 1 P. M., arriving in St. Louis Monday, October 19, at 6:56 P. M.

Delegates from all points East can connect with the special at Albany, N. Y.

Schedule and One-way Fares. Sunday, October 18, 1896.

Stations.	One Fare.	Berth.	Room.	Schedule.
Boston	$26.25	$6.50	$24.00	10:30 A.M.
Worcester	25.25	6.50	24.00	11:42 A.M.
Springfield	24.25	6.00	22.00	1:14 P.M.
Pittsfield	23,90	6.00	22.00	2:52 P.M.
New York	24.25	6.00	22.00	1:00 P.M.
Poughkeepsie	23.25	6.00	22.00	2:43 P.M.
Albany	22.75	5.50	20.00	4:20 P.M.
Troy	22.75	5.50	20.00	
Utica	21.75	5.00	18.00	6:34 P.M.
Syracuse	23.25	5.00	18.00	8:00 P,M.
Rochester	20.25	4.00	14.00	9:50 P.M.
Buffalo	19.25	4.00	14.00	10:50 P.M.
Erie	17.10	4.00	14.00	
Cleveland	15,00	3.00	10.00	3:30 A.M.
Indianapolis, Arr.				11:28 A.M.

Train is due to arrive at St. Louis, 6:56, Monday evening.

On presentation of certificate at St. Louis, return ticket will be furnished at one-third our rates.

The special rate of a fare and a third for the round trip has been granted from all eastern points. Delegates will ask ticket agent for certificate, which, when properly countersigned at St. Louis, will entitle the holder to a return trip at one-third the regular fare.

The committee in charge would respectfully urge all who intend to take this special train to apply at once in

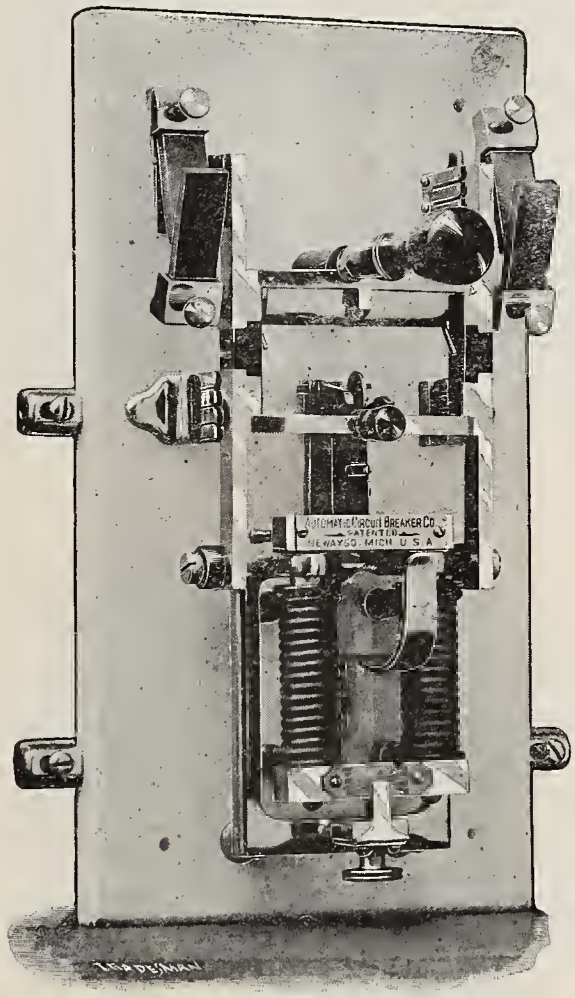
order that ample accommodations may be provided and proper assignments made.

Inquiries relating to the reservation of berths, tickets, etc., should be addressed to M. C. Roach, general eastern passenger agent, 413 Broadway, New York. Delegates from New England points apply to J. L. White, agent, B. & A. R. R., 366 Washington street, Boston.

H. H. Vreeland, Chairman.
President Metropolitan Street Railway Co.
Jas. H. McGraw, Havemeyer Building, N. Y.
Charles W. Price, 13 Park Row, N. Y.
Committee.

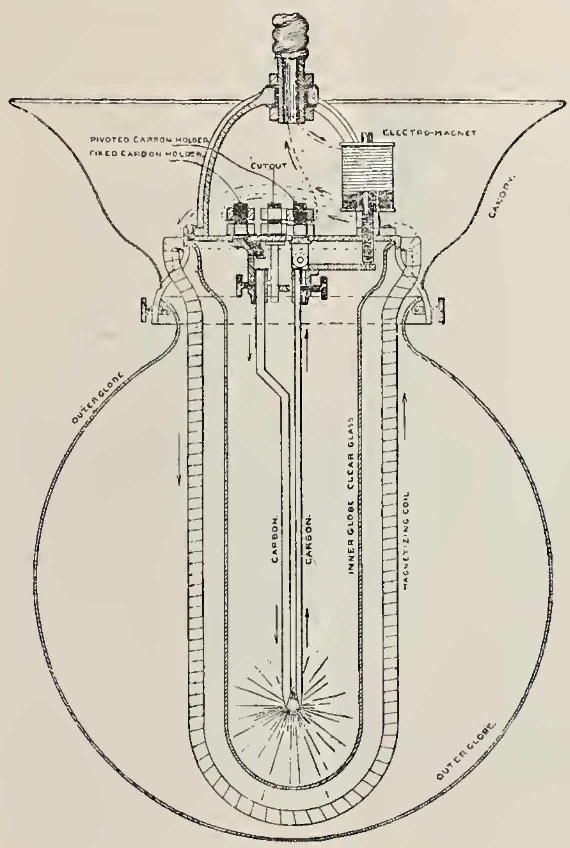
ELMER P. MORRIS.

Mr. Elmer P. Morris, No. 36 Dey street, N. Y., an enterprising and able business man, has secured the agency for the Automatic Electric Circuit Breaker Co's. non-arcing circuit breakers of Newaygo, Mich.; agency for the Nowotny Electric Co's. incandescent arc lamps; agency for the Electric Railway Equipment Co., of Cincinnati, Ohio, handling their iron poles, brackets and overhead line materials; also simplex interior telephones. He is doing a heavy business in Monarch paint. His ability and careful attention to business make him a valuable man to any firm.



Newago Automatic Circuit Breaker.

Efficiency of Gas Engines.—The report on a test of an isolated gas-engine electric lighting plant shows the character of the work in engineering. It shows, further that, for above 30 lamps, the gas may be profitably burned in the gas engine.—University Scientific Magazine.



Nowotny Arc Lamp.

Ottawa, Ont.—Incorporation is asked for the Canadian Electric Light and Power Company, which proposes to build an electric railway from Cobourg, via Port Hope, Toronto and Hamilton, to Suspension Bridge, with branch lines.

COMBINED AUGER AND REAMER.

This tool is specially recommended for telegraph, telephone, electric light and power, pole and cross-arm construction, electric cabinet work, etc. This tool bores a hole and then widens it at the bottom.

A wedge-shaped piece is then placed in the enlarged bottom, and whatever is to be fastened is driven down upon the wedge which splits it for a short distance, and the chair-rung, mallet handle, or any kind of tenon is crowded into the enlarged space and held firmly. Thus no glue is needed. Iron can be softened by heat and held in stone without solder.

In bolting sheathing to an iron vessel, the bolt can be cylindrical, and threaded with a screw thread; and by fitting tapered segments, likewise threaded in the hole bored and enlarged by this tool, the bolt is held firmly, without any need of a nut or rivetted head, as the bolt does not go through the opposite side, but ends in the sheathing.

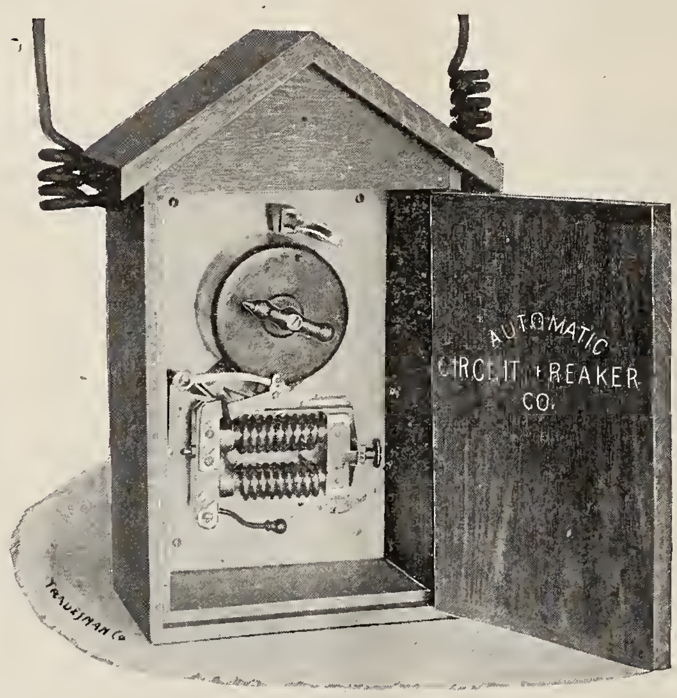
Building stone is chiselled by hand to hold the hoisting clamp. This tool does the work in one-tenth the time.

A hole bored by this tool gives a firm hold in using bowling balls.

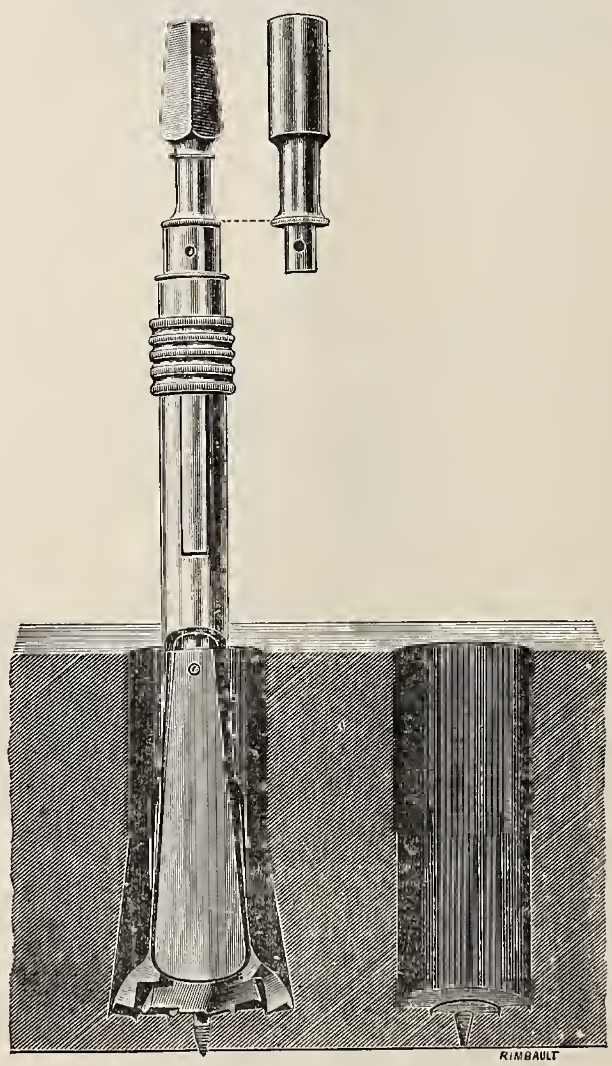
For chair-work, mallets, croquet mallets, ladders, rakes, things held by wooden handles, ship-building, felloes, spokes, wherever a mortise and tenon is used, the tool must supersede all other methods.

It can be divided so as to dispense with the borer, and used only to ream out holes already widened. This makes a separate tool.

John Henry Hull, patentee, 41 Park Row, New York City.



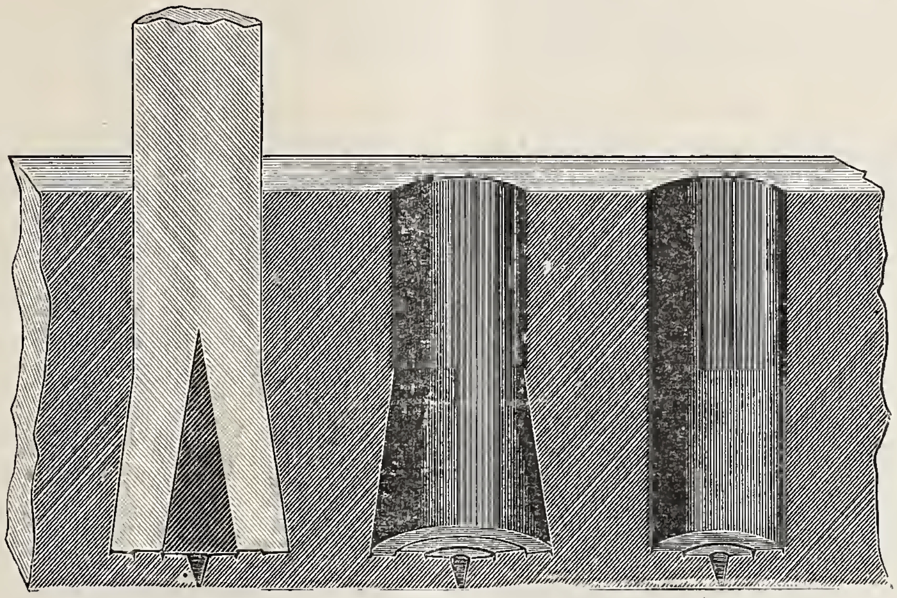
Newaygo Automatic Circuit Breaker.



Cross-Section of Reamer.

Nigara Falls, Ont.—A Toronto syndicate propose purchasing the street railway charter here and will convert the road into an electric line.

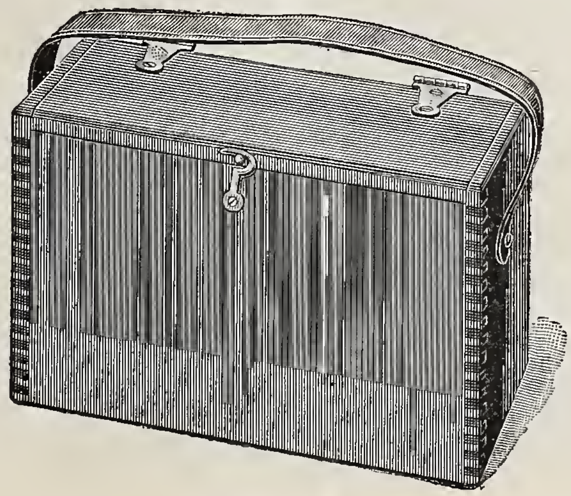
Rutland, Vt.—E. N. Sanctuary, of Burlington, has completed a survey for an increased power for the Vergennes electric light plant.



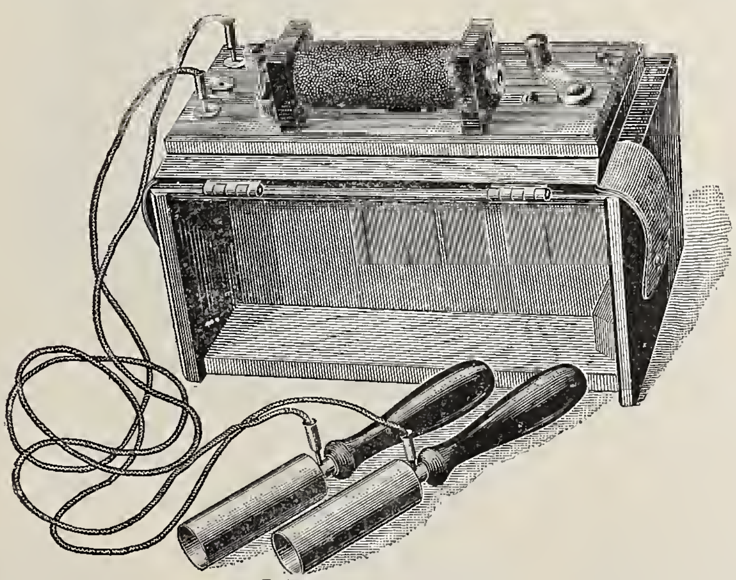
This Tool Bores a Hole and then Widens it at the Bottom.

J MEDICAL BATTERY.

J. Jones & Son, No. 67 Cortlandt street, are selling one of the nicest looking little medical batteries we have ever seen. It is of excellent mechanical construction, being mounted upon the lid of a polished oak case. When the lid is lifted the coil appears. A switch starts it into operation, the coil being fed by a dry cell within. The box cannot be closed unless the switch is open. It is carried by means of a broad strap, making it look like a camera case. It only weighs 3½ pounds and is 7½x5x3½ inches. A set of hand electrodes, two silk conducting cords with tips, two insulating handles or sponge electrodes, are supplied with each outfit. The whole complete is sold for $6.00. The neatness and excellence of the coil is such that we highly recommend it.



J Battery Closed.



J Battery Open.

Mr. H. Krantz, the well-known manufacturer of switches, was married September 24, at Zion's Church to Miss Metta M. Kolle, daughter of Mr. John Kolle, the prominent South Brooklyn builder and proprietor of Prospect Hall.

The bridal couple left for Washington, D. C.; had it not been for business engagements Mr. Krantz would have crossed the ocean for a longer trip. We wish them prosperity and happiness. Mr. Krantz has his factory at Nos. 626–630 Fourth avenue, Brooklyn.

J. Jones & Son, general electrical supply dealers, No. 67 Cortlandt street, New York, have issued a fine new catalogue of their goods. They are an enterprising firm and have met with merited success,

Niagara Falls, Ont.—It is the intention of the directors of the Niagara Falls Park and River Railway Company to extend the road.

POSSIBLE CONTRACTS.

Philadelphia, Pa.—Plans are being prepared by Architect J. C. Newson for a new building for the Broadway Methodist Episcopal Church, Camden. These latest improvements are included in the contract: Steam heating, electric light, ventilation, electrical work, including wiring, bells and combination gas fixtures. The total cost of the church will be about $60,000.

Architects Waters & Hinckle, 500 Walnut street, have finished plans for 25 houses. They will be two stories high, to cost $60,000. The following latest improvements will be included in the contract: Hot air heating, gas fixtures, electrical work, including wiring, bells, etc.

Plans have been prepared for a large paper warehouse, to be built at Fifth and Commerce streets. The building will be five stories.

Stewart Bros. are about to build for Henry K. Wampole & Co., of 441 Green street, a four-story brick warehouse on the north side of Lynd street, between Fourth and Fifth.

Jacob Myers & Sons, builders, Juniper and Sansom streets, are putting up a four-story office building 1317 Sansom street.

Architect Walter Smedley has prepared plans and is about to award separate contracts for residence at Wynnefield Station for Mr. T. F. Reilly. It will be three stories high. Steam heating, electric lighting, speaking tubes and electric bells will be included in the general contract. The cost will be about $10,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued August 25, 1896.

566,760. Electric Switch. J. L. Hornig, St. Louis, Mo. Filed February 26, 1896.

566,784. Selective System. A. L. Merrick and B. Brooks, Springfield, Mass. Filed September 16, 1892.

556,786. Electric Railway System. J. M. Murphy and A. F. Pierce, Danbury, Conn. Filed September 10, 1895.

566,795. Electric Heater. F. L. Pruyn, Albany, N. Y. Filed August 1, 1895.

566,801. Electric Railway System. W. Robinson, Boston, Mass. Filed December 19, 1894.

566,843. Tower-Striker. F. W. Cole, Newton, Mass. Filed July 24, 1894.

566,860. Electrical Construction, Regulation and Distribution. T. H. Hicks, Detroit, Mich. Filed February 1, 1895.

566,874. Electrical Distribution Machine. W. E. Sinclair, Milwaukee, Wis. Filed July 25, 1895.

566,887. Detector for Railway Switches. W. H. Berrigan, Jr., Brooklyn, N. Y. Filed April 26, 1895.

566,889. Electric Motor. J. Bram, Decatur, Ill. Filed September 5, 1895.

566,892. Regulating Socket for Electric Lamps. C. A. Chute, Chicago, Ill. Filed February 8, 1896.

566,894. Apparatus for Extracting Gold and Silver from Ore. P. Danckwardt, New York, N. Y. Filed June 8, 1896.

566,896. Electrical Selecting Instrument. A. Duppler, Jersey City, N. J. Filed February 12, 1895.

566,914. Electric Selector. A. le Blanc, New York. N. Y. Filed October 3, 1893.

566,915. Electric Selector. A. le Blanc, New York, N. Y. Filed November 11, 1893.

566,916. Selecting Device. A. le Blanc, New York, N. Y. Filed January 16, 1894.

566,917. Electrical Transmitting Instrument. A. le Blanc, New York, N. Y. Filed October 16, 1894.

566,918. Electromagnet. A. le Blanc, New York, N. Y. Filed October 16, 1894.

566,936. Automatic Starter for Electric Motors. J. E. Putnam, Rochester, N. Y. Filed February 29, 1896.

566,939. Electric Car Brake. Alex. B. Roney, Chicago, Ill. Filed April 2, 1895.

566,951. Signaling Device. H. L. Webb, New York, N. Y. Filed March 18, 1893.

566,984. Electric Railway. R. M. Hunter, Philadelphia, Pa. Filed February 3, 1896.

566,985. Telegraphy. J. M. Joy, New York, N. Y. Filed June 17, 1895.

567,023. Automatic Circuit-Controller for Electric Pumps. D. W. Dunn, Wrentham, Mass. Filed May 1, 1895.

567,024. Plate for Secondary Voltaic Batteries. J. G. A. Rhodin, Clifton Hall, England. Filed October 7, 1895.

567,045. Plate for Secondary Voltaic Batteries. J. G. A. Rhodin, Clifton Hall, England. Filed September 25, 1895.

567,112. Electrical Communication. J. A. Sullivan, Cincinnati, O. Filed July 15, 1893.

567,118. Trolley. F. W. Canales, Portland, Me. Filed January 22, 1896.

567,119. Electric Motor. R. Eickemeyer, Yonkers, N. Y. Filed December 31, 1890.

The Electrical Age.

Vol. XVIII., No. 16. NEW YORK, OCTOBER 17, 1896. Whole No. 492

Double Track Share Plow.

SNOW PLOWS.

We illustrate on these pages two styles of snow plows, manufactured by the Taunton Locomotive Mfg. Co. of Taunton, Mass. The single-track "Standard" nose plow, as shown, has many new points of great advantage. both in operation and effectiveness. The construction of these appliances is of the most rugged and durable character, and they are designed for the hardest kind of work. Among the numerous improvements over the ordinary types of plows may be mentioned the wing mechanism, the curved shape of the nose and the counter-balances which, beside making each nose independent of the other, greatly lessen the exertion usually necessary in raising and lowering the noses. The wings are operated by ropes which pass over a wheel in the side of the house, as may be seen by referring to the illustration. At the ends of these ropes, inside the house, are attached weights running on perpendicular side rails. To open the wings, these weights are raised by means of handles suitably placed, with which lift the wings fall of their own weight and are locked in position, being braced by a heavy iron bar. To close the wings, all that is necessary is for the operator to put a quick pressure on the handles of the weights described above, whereupon the wings are raised, folded and locked. (The illustration shows wings open and shut.) The diggers are operated by levers at each end of the house, and are most simple and effective in their working. The curved nose makes it impossible for the snow to "ride up" and the counter-balances make it possible to operate each nose independently of the other.

The double-track share plow is built for city and suburban work where two tracks are laid. The share, which lies at an angle of 45 degrees to the rail, is made of 3/8" steel, and at any desired height. It has the same curved shape, which is very effective in rolling the snow over and distributing it evenly at one side of the track. It also has the same independent counter-balance for each share, making the operation very easy. The wings in this appliance are worked by means of levers, which are very simple in manipulation and are absolutely in control of the operator. The illustration shows one of the five share plows in use on the New York & Queens County Railway, of Long Island City, N. Y., where they were put through the hardest kind of work and performed it in a way which earned the highest praises from the General Manager, Mr. Chambers, and others in authority.

These Taunton appliances have made an enviable reputation in various parts of the country, and it is no exaggeration to say that their design and construction, and the excellent results which they have attained, go to prove

that they represent the highest development and the farthest advancement in snow plow manufacture. The agents of the Taunton Locomtive Mfg. Co. are Messrs. Wendell & MacDuffie, 26 Cortlandt street, New York, to whom we are indebted for the accompanying illustrations.

RAILWAY POWER STATIONS.

By Thomas Henning, Buffalo, N. Y.

At no time since the advent of the now ubiquitous trolley has there been more energy, ingenuity and enterprise expended upon its improvement than at present.

Of course, the commercial view is the all-important one to business men, notwithstanding which, when one follows the peregrinations of the various factors that, combined, turn the wheels of a trolley car and observe the thousand and one loop-holes by which energy is allowed to escape without performing useful work, one would imagine for a moment that one or two roads have been constructed and maintained for amusement.

Permit me to call your attention to a few of the errors made in years gone by.

The first question of vital importance presenting itself will be the site. Should an experienced man be called upon to choose a site, it would cost a few dollars. For this reason inexperienced persons have at times done the work, and chosen the site for the reason that it was in the vicinity of the work to be performed, regardless of the questious pertaining to fuel and water, or they may have chosen it owing to the contiguity of one factor and disregarding the remaining factors. This is a more expensive method than paying for having the matter properly attended to.

In the construction of a plant heavy losses are frequently borne owing to misplaced material, which, being lost sight of, necessitate duplicate requisitions, etc. A clercial force sufficiently large to keep an accurate account of all material required, ordered, received and used, will pay a handsome profit on the outlay.

In operation we are again confronted with many wasteful outlets. The pumps may be kept in service without examination until convenience or absolute necessity compels action. The boilers will scale on one side of the tube and soot on the other. The steam-pipe covering, defective. The engines in service, without overhauling until they quietly refuse to do further duty. The dynamo commutators rough, or brushes not properly fitted to them. Switches and loads of insufficient capacity, switches unclean, their faces rough and lug joints not properly made. The feeders inadequate for the work required of them. Motor commutators and brushes neglected and, finally, the rails not properly bonded, if bonded at all.

I have known of instances of units having been kept in service under full loads and overloads (notwithstanding the fact that there were units idle) upon the theory that the larger the output from each unit the greater the economy. I believe that this is a delusion and should be avoided. It is not economical to overload any part of the plant unless absolutely necessary.

All these weak spots waste money every minute that the system is in operation. It may be that each person concerned is so absorbed in devising new and novel means for the propulsion of cars and for other purposes that it is forgotten, for a time, to make the best of our present opportunities. When a weak spot is observable in any part of the system, repairs should be begun at the earliest possible moment. If allowed to run along until necessity compels them, it will prove to be a very expensive and a very dangerous practice.

In stations of 2,000 H. P. or over it will pay to extract the oil from the wipers, which may be done by enclosing them in a tank, into which a steam jet has been inserted; the oil upon rising to the top of the tank may be drawn off for purification, the wipers dried out and used again, repeating the operation until the wipers are worn out.

There is nothing connected with a power station that will pay a larger dividend than cleanliness. If the station be kept scrupulously clean, the employees will take more interest in their work and the treasurer will not be called upon to pay for so many tools and other things lost and misplaced.

Of course, as science and capital are moving along rapidly hand in hand, we may reasonably expect in the near future to be able to eliminate some of these factors which tend to swell the cost of power. The success of long distance transmission, and the improvements quietly but continually being made in motors, dynamos, and other electrical appliances, indicate that the time is approaching when we may expect a higher efficiency in all branches of the service.

As an earnest of this I may instance the bold but brilliant move of General Manager Littell, of the Buffalo Railway Company, in arranging to carry his patrons to Divine Service on Thanksgiving Day, 1896, by power generated by the waterfall of the Niagara River, over twenty miles away.

Before concluding, permit me to draw your attention to a matter which is frequently overlooked—the cost of operating a power station is frequently figured upon the basis of car-miles. This is liable to be very deceptive and may militate against a well-managed station, for the reason that insufficient copper, poor bonding, and defective car equipments would necessarily make a bad showing for any station.

The correct method will be to note the output at the bus-bar and figure upon the basis of electrical horsepower.

Within the past few months the problem of how to utilize the waste heat from cylinder boilers has presented itself before the mining engineers of Pennsylvania, in such a positive manner as to cause several to take up the subject in earnest, and it may be of interest to our readers to know just what steps have been taken, and what results have been obtained on this important subject.

The first gentleman to experiment in this line was Mr. Irving A. Stearns, general manager of the Susquehanna Coal Co., and the several other companies controlled by the Penna. R. R., and the place selected for the experiment was in the rear of twelve cylinder boilers 30 ins. in diameter, and 30 feet long, located at number two shaft boiler house of the Susquehanna Coal Co., Nanticoke, Pa.

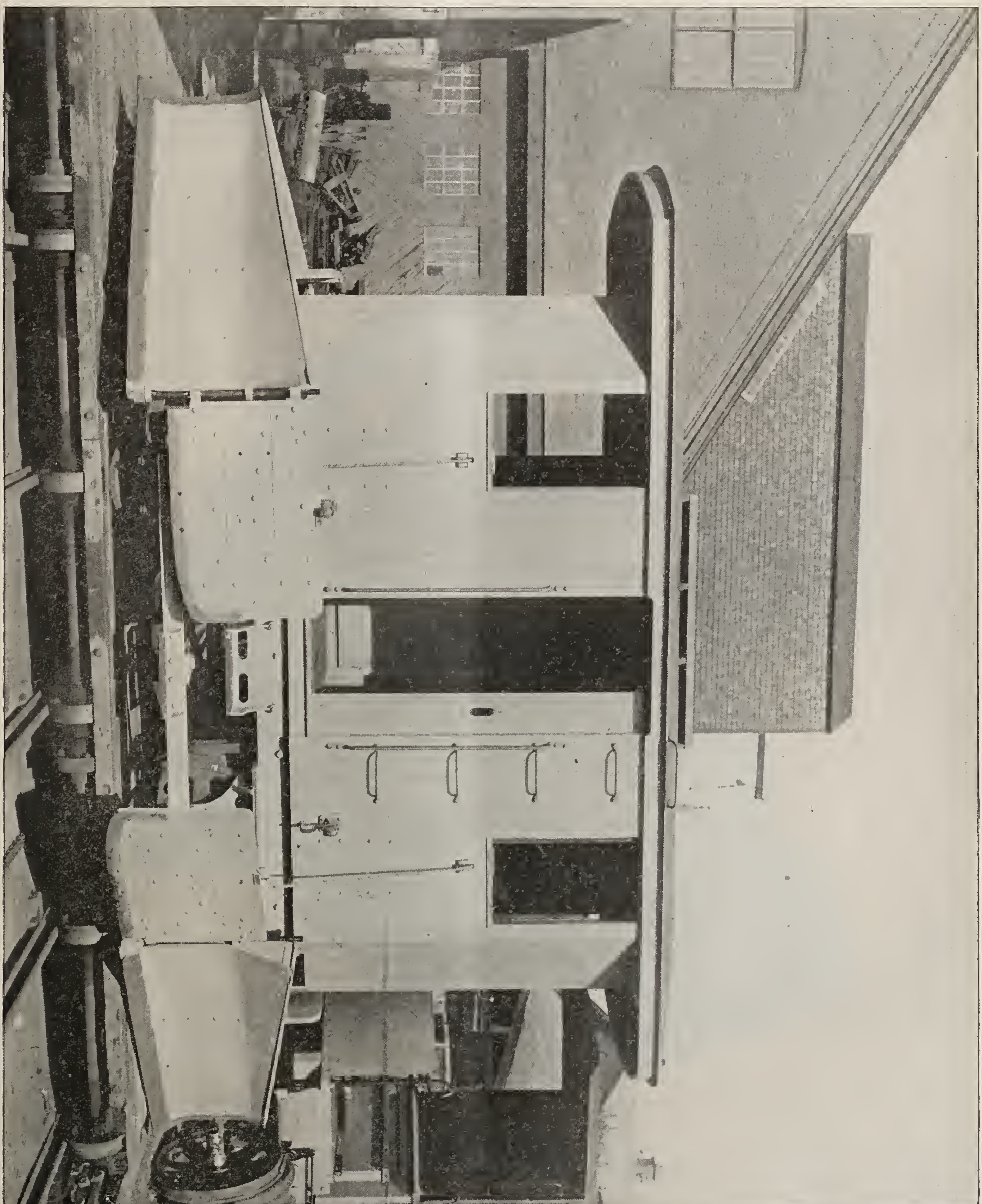
By the means of the pyrometer, Mr. Stearns found the temperature of the gases going to waste in the stacks ranged from 1,500° to 2,000°; 1,500° with the blowers off, and 2,000° when on. This warranted him in seeing just how much of this waste heat could be utilized in making more steam, without altering the existing conditions of firing or using an ounce more coal. With this object in view he placed a 400 h. p. Morrin "Climax" steam generator (a vertical boiler—nothing more nor less than a large smoke-stack, 11 feet 2 inches in diameter, and 26 feet 6 inches high, containing a heating surface of 3,940 square feet, made up of loop-like tubes expanded into cylindrical shell 40 ins. diameter, by which a rapid and continuous circulation of water is maintained) between the two stacks that carried off the waste gases from the twelve cylinder boilers. Two brick flues conducted the gases to the Climax boiler; entering at the base diametrically opposite to each other, the old stacks being temporarily cut off by iron doors in case it became necessary to clean it, in which case the door leading to the stacks could be raised and the Climax generator shut off.

The results of tests on Climax steam generator made, on Feb. 21, from waste heat alone, burning No. 2 buckwheat coal under cylinder boilers, is as follows:

Temperature of Feedwater,	150°
" " Feed flue,	520°
Steam Pressure,	85 lbs.

Pounds of Water Evaporated per hour,	.	16,513 lbs.
" " " from and at 212°		18,171 lbs.
Horse-power developed, boilers working under blast,	. . . . . .	526.7 H. P.

Horse-power based on evaporation of 34 lbs. water per hour; from and at 212° 30 lbs.; from 100° feed to 70 lbs. steam.



The Standard Nose Plow.

The above results obtained by actual test afford some idea of the amount of heat going to waste, and at the same time prove the value of the Climax steam generator for the utilization of same, for it can now be confidently asserted that where cylinder boilers are used it is possible to double the horse-power capacity without having to use an ounce more coal or employ another hand.

—Reostene, a New Resistance Metal, spoken of by "London Invention," formed the subject of a paper by Dr. J. A. Harker and Mr. A. Davidson, read at the British Association meeting. The metal described is an alloy containing iron and nickel; its specific resistance is higher than that of manganin, being about 46 times that of Matthiessen's copper. The temperature coefficient is positive, exceedingly constant, and equal to about 0.0011 per degree Centigrade. In reply to a question, Dr. Harker said the wire oxidized only slowly in air—almost similarly to German silver. The different specimens had an almost identical specific resistance, differing in the extremes by only five per cent. The wire is soft and it can be easily drawn out.

IMPROVED AMERICAN GIANT DYNAMO.

The Zucker & Levett & Loeb Company's 1896 type of the improved American giant dynamo is a six-pole steel machine with a commutator at each end of the armature. These machines are built of the very best materials, of generous proportions, and run at the low speed of 400 to 500 revolutions per minute. They run cool and with but little friction.

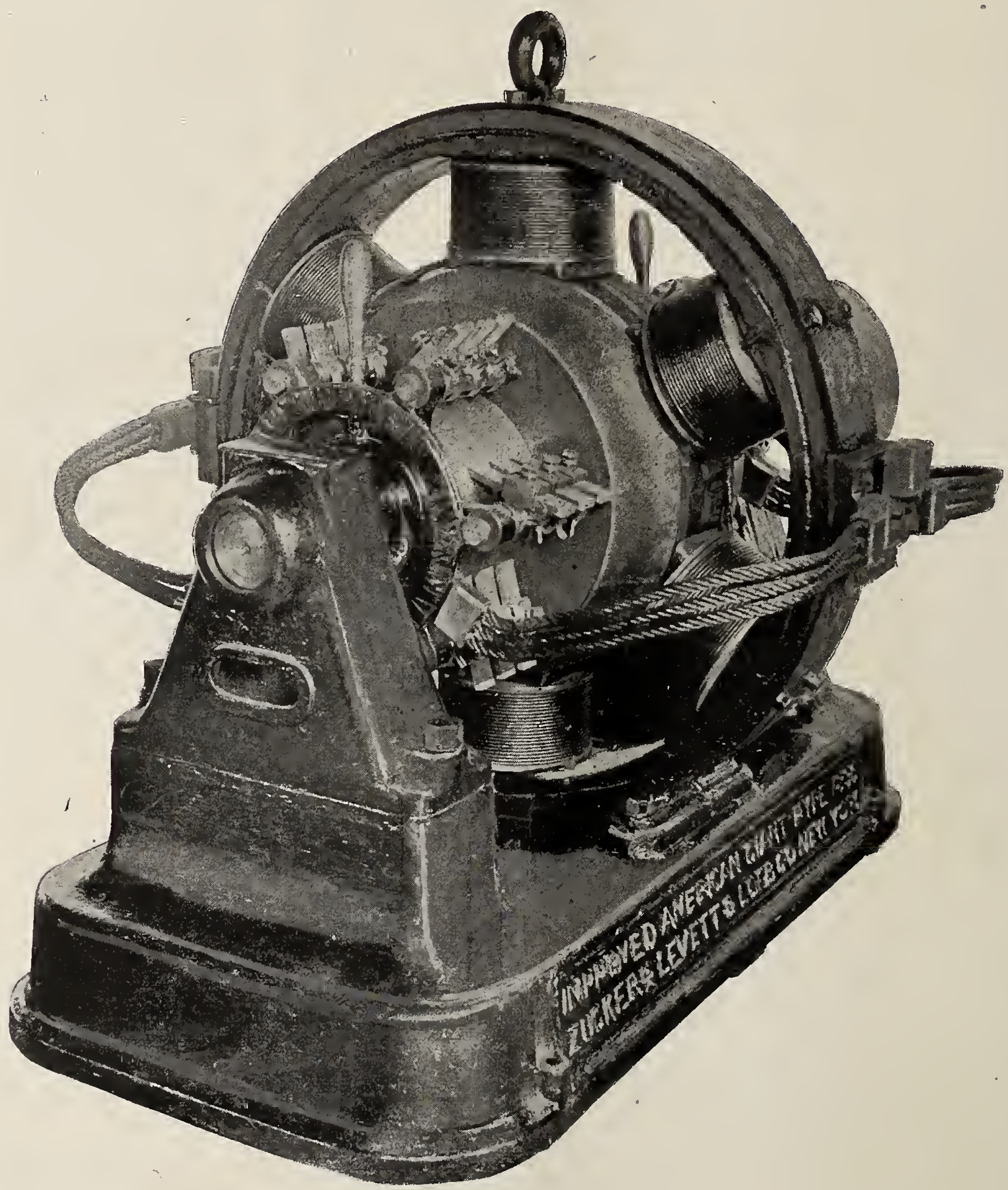
Heretofore one of the weak points of plating dynamos was an insufficient brush surface. This has been carefully obviated in the 1896 type improved American giant dynamo, they having double the brush surface per ampere of any low voltage machine built.

Low voltage dynamos require an excessively large commutator. The above arrangement of two commutators was adopted with a view of obtaining a more symmetrical machine. Some of the electrical features of this arrangement are entirely novel. The two windings are carefully insulated from each other by field insulation and the burning out of one enables the machine to be run on something like a two-thirds load until repairs can be effected.

When requested these dynamos are so connected that the windings may be thrown either in parallel or in series. This is very convenient and economical in the case of a plating room where solutions requiring different intensity are used, as in such a place the current can be taken from the dynamo at two different voltages by connecting the leads to the terminals of one of the windings, or of the two in series. The lower voltage would be used for depositing nickel, gold, silver, etc., and the higher voltage for such solutions as brass or cyanide of copper, which take from six to twelve volts.

By careful design this machine has been built self-exciting, at the same time giving an almost level characteristic curve and very high efficiency, with the larger size of machines only from three to four per cent. of the armature current being used in the fields. The C^2R and hysteresis losses are also very low.

Up to the present time no other self-exciting dynamo of this class has met with results to compare with the results of the 1896 type improved American giant dynamo, the results given being remarkable, in view of the difficulties of designing large current, low voltage, shunt dynamos.



Improved American Giant Dynamo.

These machines are being built of any size from 750 to 4,000 amperes, the smaller machines being of six poles and the larger of a greater number.

Manufactured by the Zucker & Levett & Loeb Co., No. 527 West 25th street, New York.

Revelstoke, B. C.—The Revelstoke Water-Works and Power and Light Company will seek incorporation at the next session of the provincial legislature. Messrs. W. Cowan, J. Abrahamson, W. M. Brown, and T. Downs being the promoters.

Convention Programme.—The official programme of the proceedings of the American Street Railway Association, extending over a period of three days, will cover the following papers:

(1) Track and Track Joints, Construction, Maintenance and Binding.

(2) Trucks.

(3) How can the revenues of street railways be increased, taking into consideration the collection of fares, method of registry, transfers, use of tickets or cash fare, and attractions along the line of road?

(4) Modern overhead electric construction.

(5) The modern power house.

(6) Selection and management of employees.

These papers will be discussed at an executive session of the association. An excellent exposition of street railway supplies will be shown in the main hall. It is going to be the best of its kind ever shown. Plenty of power and light and the additional necessary conveniences will be found in the hall for exhibitors.

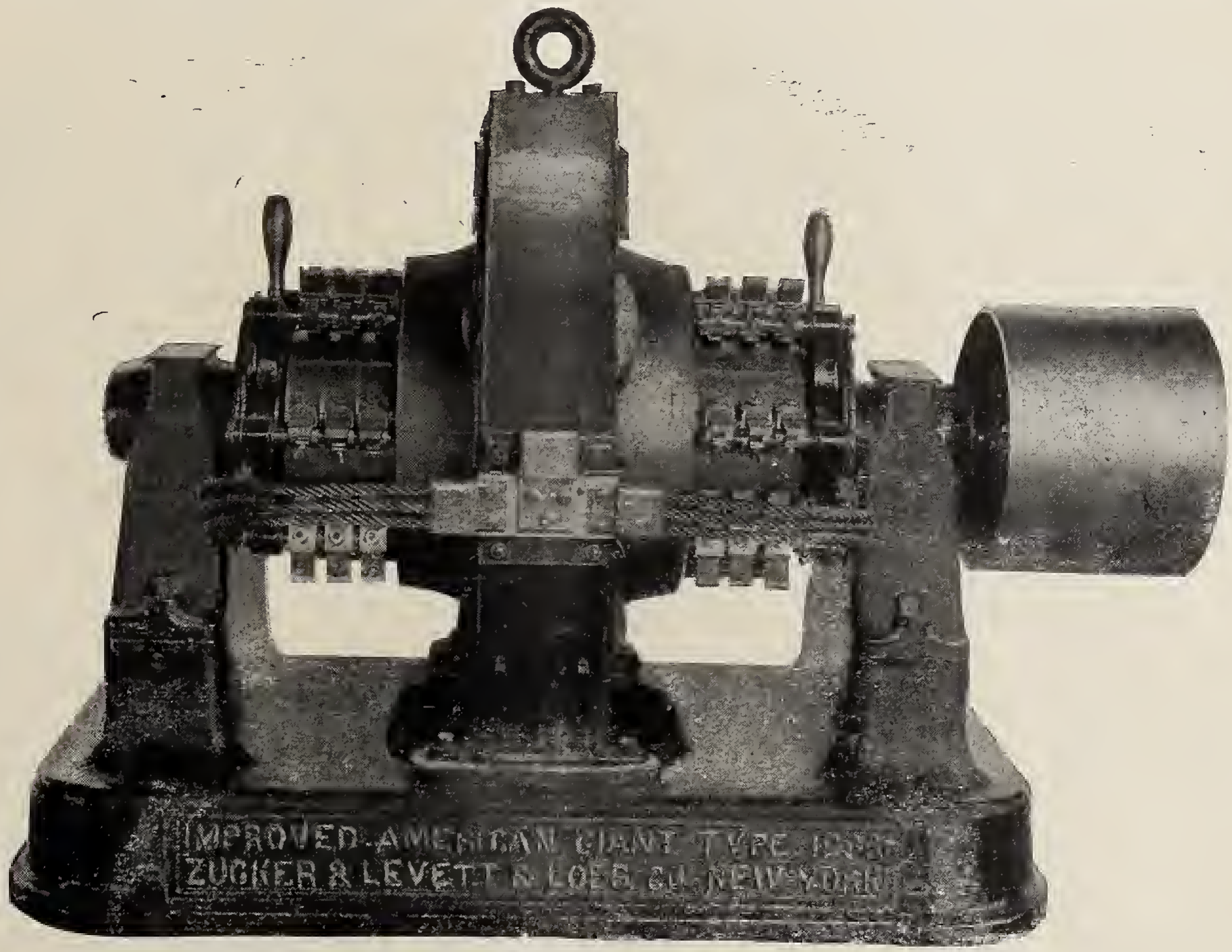
Purchase of tickets.—Tickets must be obtained at least three days before the date of the meeting (October 20), and upon request, the ticket agent will issue a certificate to purchaser.

"Under the rules of the Passenger Association it will be necessary for all persons holding certificates to deposit them with the clerk when they arrive at the hall on Tuesday, October 20. He will have them signed and vised and they will be ready for return to you Thursday at 1:00 P. M. This is important if you wish to avail yourselves of the one-third return fare. Please take notice and govern yourself accordingly."

Hotels.—The headquarters of the association will be the Southern Hotel. In addition to these good accommodations can be found at the Planters, St. Nicholas, Hurst's or the Lindell Hotel. The European and American plans prevail in all hotels. The majority of them are within easy distance of the Convention Hall. The beauty of St. Louis, its historic reminiscences and its social and business life will provide a novel and interesting scene for all eastern visitors.

Western hospitality will be extended to delegates with all its warm and attractive features.

An Electric Dredger.—The Philadelphia Record states that an electric dredger of novel construction has recently been built at Rotterdam for use on the river Esla, in Spain. The principal featare in connection with this dredger is that the motive force, in the form of electrical energy of high tension, may be generated on shore by any convenient means, the current being distributed either by overhead wires or cables laid under the water. In the particular installation under notice the central station is situated on the river bank and furnishes current not only to the dredger, but also to work an elevator which returns the material dredged into lighters and ballast wagons. All the motions are controlled by one man in the cabin. When once in position a heavy metallic pile situated on the central line abaft the chain is allowed to fall, and penetrates by its own weight the bed of the river, forming a pivot around which the dredger can be made to describe circles, the movement being effected by two screws situated near the bow and operated by electric motors in such a manner that the boat may be rotated in either direction. When all the material lying in the circle of operations, of which the fixed pile is the centre and the end of the bucket chain the radius, has been removed, a second pile at the stern, but not on the central line of the dredger, is allowed to fall, and the first one is raised. The second pile now forms the pivot around which operations are conducted, and it will be readily understood that when the necessary depth has been dredged by dropping the first pile again when the boat has reached a predetermined position, a new area for dredging is reached. The winches for operating the bucket chain and raising the piles are operated by electric motors controlled in the cabin. The motor for operating the bucket chain is capable of developing 45 horse-power when making 600 revolutions per minute, the reduction of speed being effected by intermediate pulleys and belting in the usual way. The average power required to work the dredger is equal to about fifteen horses, and as the motor is equal to 45 horse-power in normal working a good margin is left for emergency. The dynamo machines, besides operating the motors for driving the screws, driving the dredge chain, raising the dredge frame and lifting the piles by electrical energy, also work a centrifugal pump.



Improved American Giant Dynamo.

STANDARDS OF LIGHT.

PRELIMINARY REPORT OF THE SUB-COMMITTEE OF THE INSTITUTE.

(Continued from Page 588.)

BY EDWARD L NICHOLS, CLAYTON H. SHARP, AND CHARLES P. MATTHEWS.

It is to be understood that, in the case of each of these runs, except the one when curve VIII. was taken, the greatest care was exercised to have the room as quiet as possible. Curve VII. was the first of the Hefner lamp curves taken, and the need of extraordinary care in excluding drafts of air was not appreciated.

Data concerning the curves in Fig. 15 are given in the following Table X.

The highest point on the Hefner curves is 1.093 of the mean, and the lowest is 0.867, giving a total deviation of 22.6 per cent. This large deviation is not so significant, however, as a similar one in the case of candles, since in dealing with the Hefner lamp we have to do with an adjustable flame, and these fluctuations may indicate only that a slight readjustment was needed.

The most important question in regard to the Hefner lamp is the accuracy with which it can be adjusted to its normal light intensity. Some idea may be formed of this by noting in Table II. the percentage deviations of the first five minutes of each of the curves from the mean ordinate of the first five minutes of all the curves. The maximum deviation will be seen to be 8 per cent., while the mean deviation is 2.3 per cent.

	Time: Minutes on curve.	Mean ordinates and their mean.	Deviations from the mean ordinate of the curve.	Deviations reduced to percentages.	Deviations from mean ordinate of all the Hefner lamp curves.	Deviations from general mean reduced to percentages.
Curve VIII.	70–75	38.91	−1.12	−2.80	+0.27	+0.70
	75–80	39.83	−0.20	−0.50	+1.19	+3.08
	80–85	40.54	+0.51	+1.28	+1.90	+4.92
	85–90	40.86	+0.83	+2.08	+2.22	+5.74
		40.03				
Curve IX.	0–5	38.26	−0.54	−1.39	−0.38	−0.98
	5–10	38.62	−0.18	−0.46	−0.02	−0.05
	10–15	38.97	+0.17	+0.44	+0.33	+0.85
	15–20	38.87	+0.07	+0.18	+0.23	+0.59
	20–25	39.04	+0.24	+0.62	+0.40	+1.03
	25–30	39.03	+0.23	+0.59	+0.39	+1.01
		38.80				
Curve X.	30–35	38.89	0	0	+0.25	+0.65
	35–40	39.16	+0.27	+0.70	+0.52	+1.34
	40–45	38.62	−0.27	−0.70	−0.02	−0.05
		38.89				
Curve XI.	45–50	39.42	−0.83	−2.06	+0.78	+2.02
	50–55	40.50	−0.10	−0.25	+1.51	+3.91
	55–60	40.50	+0.25	+0.62	+1.86	+4.81
	60–65	40.92	+0.67	+1.67	+2.28	+5.90
		40.25				
Curve XI. (a,) (b) and (c.)	70	39.37	−0.24	−0.61	+0.73	+1.89
	75–80	40.00	+0.39	+0.98	+1.36	+3.52
	85–90	39.46	−0.15	−0.38	+0.82	+2.12
		39.61				
Curve XII.	0–5	36.47	−0.90	−2.27	−2.17	−5.62
	5–10	37.21	−0.16	−0.43	−1.43	−3.70
	10–15	37.85	+0.48	+1.28	−0.79	−2.05
	15–20	37.94	+0.57	+1.52	−0.70	−1.81
		37.37				
Curve XII. (a)	25–30	35.53	+0.67	−1.85	−3.11	−8.03
	30–35	35.73	+0.47	−1.30	−2.91	−7.52
	35–40	36.38	−0.18	+0.50	−2.26	−5.84
	40–45	37.18	−0.98	+2.71	−1.46	−3.78
		36.20				
Curve XIII.	50–55	38.84	+0.15	+0.39	+0.20	+0.52
	55–60	38.74	+0.05	+0.13	+0.10	+0.26
	60–65	38.20	−0.49	−1.27	−0.44	−1.14
	65–70	39.00	+0.31	+0.80	+0.36	+0.93
		38.69				
Curve XIV.	75–80	38.46	−0.16	−0.41	−0.18	−0.47
	80–85	38.78	+0.16	+0.41	+0.14	+0.36
		38.62				

Mean ordinate of first five minutes of Hefner lamp curves = 38.645.
Reduced to true deflections = 38.66.

Curves XI., XI. (*a*), XI. (*b*), XI. (*c*) show the results of successive attempts to adjust the height of flame to just 40 mm., the wick having been lowered between each one. No zero and sensitiveness readings were taken between the beginning of XI. and the end of XI. (*c*).

They are of special value to show the accuracy with which the flame can be adjusted under given unchanging conditions.

From the numerical data upon which these curves are based, the following table of mean ordinates has been compiled. (See page 604.)

If, now, the assumption be made that the light-giving

(Continued on Page 604.)

The Electrical Age.

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CONTENTS.

	PAGE
EDITORIALS	
Railroads	603
The St. Louis Convention	603
GENERAL SUBJECTS	
Railway Power Stations	598
Convention Programme	601
Standards of Light	602
The St. Louis Convention	607
Electric Welding	611
TRADE NOTES	
Snow Plows	597
Improved American Giant Dynamo	600
The Walker Company	605
The Climax Gas Engine	608
Shultz Belting Co	610
Telephone Notes	612

RAILROADS.

There is a common belief in vogue that the wealth of Crœsus was a mere mark in comparison with the gigantic fortunes accumulated by the presidents of railroads.

The title of president bears its weight of responsibility, even though the glitter and pomp of its wear is a constant delusion to the idle mind.

In the year 1895 of the month of June, more than one hundred and fifty railways had passed into the hands of receivers. The one owning the greatest length of track was the Atchison, Topeka and Santa Fé, whose possessions extended over 4,438 miles.

In consequence of the increasing depression in business circles since then it is likely that many other concerns have joined the ranks of these unfortunates and swelled their number beyond two hundred. It may be of consequence to investors in electric roads to discover whether this unwholesome reflection upon the condition of steam roads in this country is due to an overwhelming competition, a reduction in passenger or freight traffic, or the increasing spread of trolley systems in, around and between towns and cities that otherwise depended upon locomotive traction.

The old adage is well illustrated in the ultimate behavior of many of these roads of smaller capacities that "In unity there is strength," by the unification of groups of them into larger and larger companies of greater reach and better financial standing.

The Pennsylvania Railroad has an annual gross revenue exceeding $60,000,000, which approximates a return of $22,000 a mile; the New York Central and Hudson River touching the mark at $40,000,000 gross annual revenue and $17,000 gross revenue per mile of line.

It is frequently believed that syndicates form for the purpose of imposing upon the public, but it may be believed that the formation of such is sometimes due to the irresistible pressure of circumstances. It is either a coalescence or bankruptcy. It may likewise be believed that the condition of electric roads is that of seeming prosperity, in the light of these facts, and speaks well for their introduction and maintenance by the people.

Like the numberless concerns transacting business and leading ephemeral lives, it may be said that steam roads differ from these only in magnitude, and consequently follow the same law in the pitiless struggle for existence. Their histories are more prolonged because they are bigger, but it seems that only those already in the field can persist, and even they are apt to be swept away with the rest by the strong tide of adversity.

THE ST. LOUIS CONVENTION.

The yearly convention of the American Street Railway Association will take place next week at St. Louis, and extend over the 20, 21 and 22d of this month.

A special train will leave the Grand Central Station, 42d street, New York, Sunday, October 18, at 1 P. M., arriving in St. Louis, Monday October 19, at 6:56 P. M.

This special moves via the New York Central and Hudson River Railroad. Provision has been made for meeting delegates from the East at Albany, N. Y. It will arrive there at 4:20 P. M., Sunday afternoon.

Immediate correspondence with M. C. Roach, general Eastern passenger agent, No. 413 Broadway, N. Y., or J. L. White, agent for the Boston and Albany R. R., No. 366 Washington street, Boston, will enable delegates to settle for their berths, tickets, etc.

For the benefit of those visiting the convention we state, that it will be necessary for all desiring to enjoy the return trip at one-third the regular rates, to inform the agent of the object of their tour and receive from him a certificate which, when countersigned at St. Louis, will give him on his way home the one-third reduction in railroad fare.

The rebate in fare cannot be obtained without the certificate, and it will be necessary to leave the same with the Secretary of the Association in St. Louis as soon as possible. The success of this convention will be hallowed in the memory of all railroad men. Some of the most powerful interests in the trade will be represented at this great gathering

---

American Institute of Electrical Engineers.—The next meeting of the Institute will be held at 12 W. 31st street, on Wednesday evening, October 21, and will be devoted to a topical discussion on the subject of

"Electric Traction Under Steam Railway Conditions."

The discussion will be opened by Dr. Chas. E. Emery, and prominent steam engineers as well as electrical engineers have accepted invitations to participate.

Arrangements are being made for a similar meeting to be held at Chicago the same evening.

It is reported in the London "Electrical Engineer," that Professor Villard, of the Ecole Normale, of Paris, has, after the unsuccessful attempts of many chemists, caused the new element argon to enter into combination with water. He found that no pressure short of 200 atmospheres would coerce argon into combination with water. The compound resulting is said to be colorless and to crystallize prettily when kept cool.

Alternating Currents and Alternating Current Machinery. Being volume II. of the Text-book on electro-magnetism and the Construction of Dynamos, by D. C. and J. P. Jackson. Price $3.50.

Mailed free on receipt of price.

TABLE X (*a*).

Curve.	Mean ordinate.	Deviation from mean.	Percentage deviation.
XI. (5m)	39.42	—0.14	—0.35
XI. (*a*)	39.37	—0.19	—0.48
XI. (*b*)	40.00	+0.44	+1.11
XI. (*c*)	39.46	—0.10	—0.25
Mean 39.56		Mean 0.57	

$$\frac{\text{German candle}}{\text{English candle}} = 1.2275$$

$$\frac{\text{Hefner light}}{\text{English candle}} = 0.9415$$

Various determinations of $\frac{\text{Hefner light}}{\text{English candle}}$ are given in Table X (*b*.)

TABLE X (b).

OBSERVER.		HEFNER. Eng. Candle.
[1]Sharp.	Candles reduced for rate	0.872
[1]Sharp.	Candles reduced for flame height	0.892
[2]Sharp & Turnbull.	Integration of energy curves	0.941
Violle		0.98
[3]Reihsanstat.	Investigations, mean value	0.876
[4]Netherland Photometry Commission		0.921
[5]S. Schiele.	Mean value	0.881

TABLE X.

	Time: Minutes on curve.	Mean ordinates and their mean.	Deviations from the mean ordinate of the curve.	Deviations reduced to percentages.	Deviations from mean ordinate of all the Hefner lamp Curves.	Deviations from general mean reduced to percentages.
Curve VII.	0–5	38.81	—0.50	—1.27	+0.17	+0.44
	5–10	40.02	+0.71	+1.81	+1.38	+3.57
	10–15	39.64	+0.33	+0.84	+1.00	+2.59
	15–20	39.19	—0.12	—0.31	+0.55	+1.42
	20–25	39.03	—0.28	—0.71	+0.39	+1.01
	25–30	39.19	—0.12	—0.31	+0.55	+1.42
		39.31				
Curve VII. (*a*).	30–35	39.96	+0.44	+1.11	+1.32	+3.42
	35–40	40.27	+0.75	+1.90	+1.63	+4.22
	40–45	39.83	+0.31	+0.79	+1.19	+3.08
	45–50	39.54	+0.02	+0.05	+0.90	+2.33
	50–55	39.09	—0.43	—1.09	+0.45	+1.16
	55–60	39.03	—0.49	—1.24	+0.39	+1.01
	60–65	39.19	—0.33	—0.84	+0.55	+1.42
	65–70	39.27	—0.25	—0.63	+0.63	+1.63
		39.52				

efficiencies of the English and German candles and of the Hefner lamp are equal, it is possible to get their relative intensities by a comparison of the mean ordinates of their curves. Reducing the deflections as read on the telescope scale to angular measure and taking double the tangents of these angles, we have for the true deflections the following values:

English candle, = 41.06
German candle, = 50.40
Hefner light, = 38.66

From these values we get the following ratios:

The value 0.94 rests on the assumption that the radiant efficiencies of the candle and Hefner flames are equal. Since the Hefner flame is distinctly redder in color than the candle flame, its radiant efficiency is probably smaller, and consequently the value 10.94 is too large.

(To be continued.)

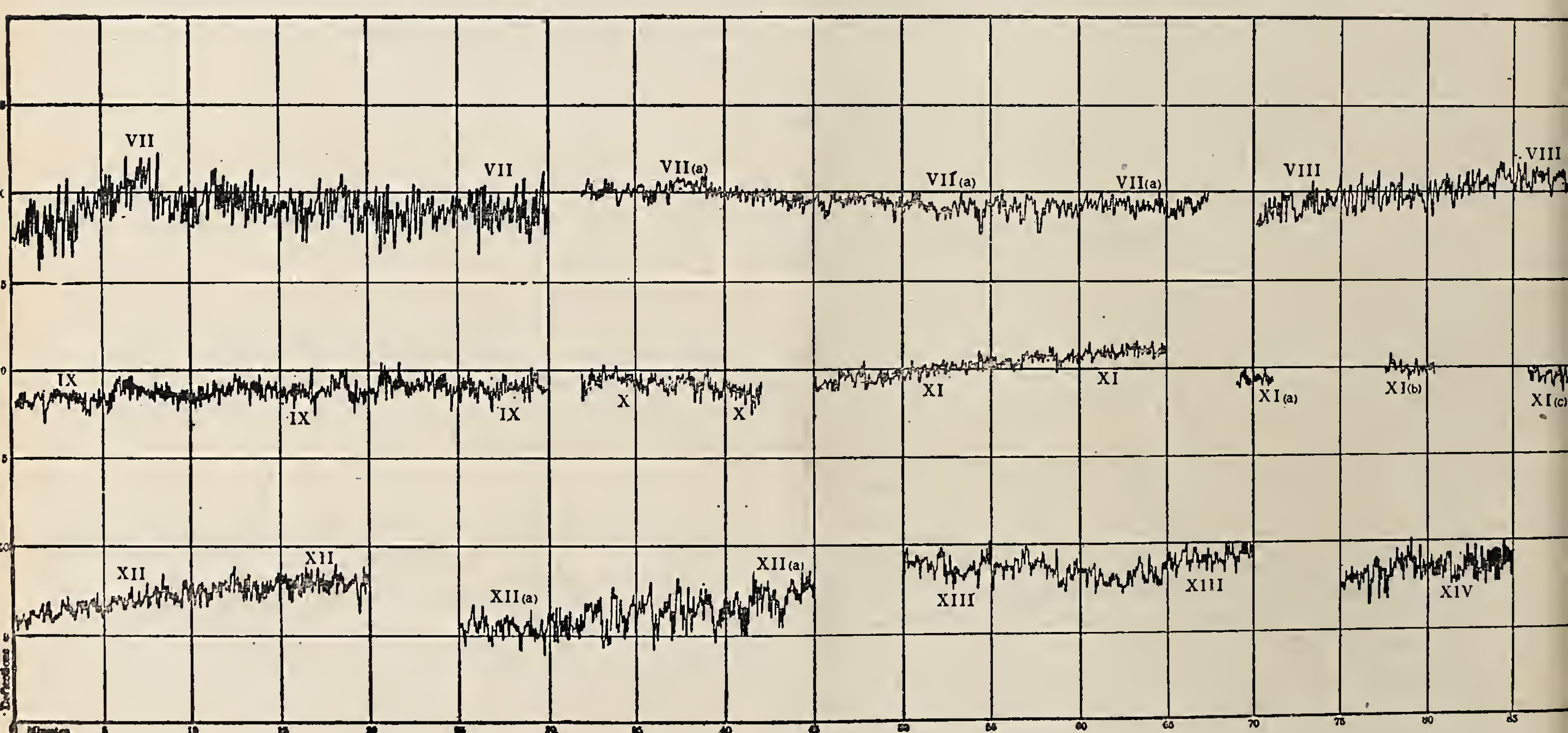
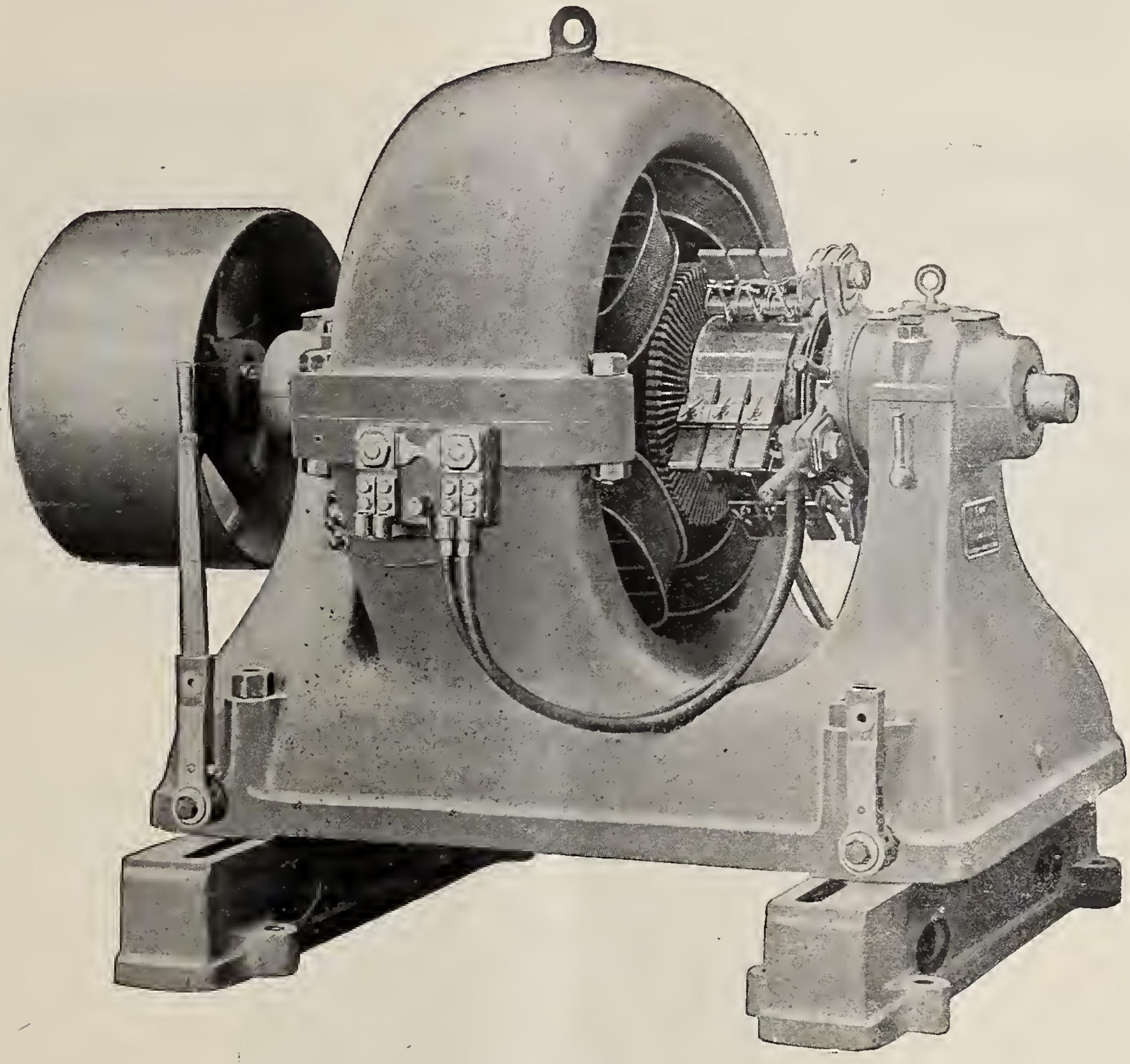


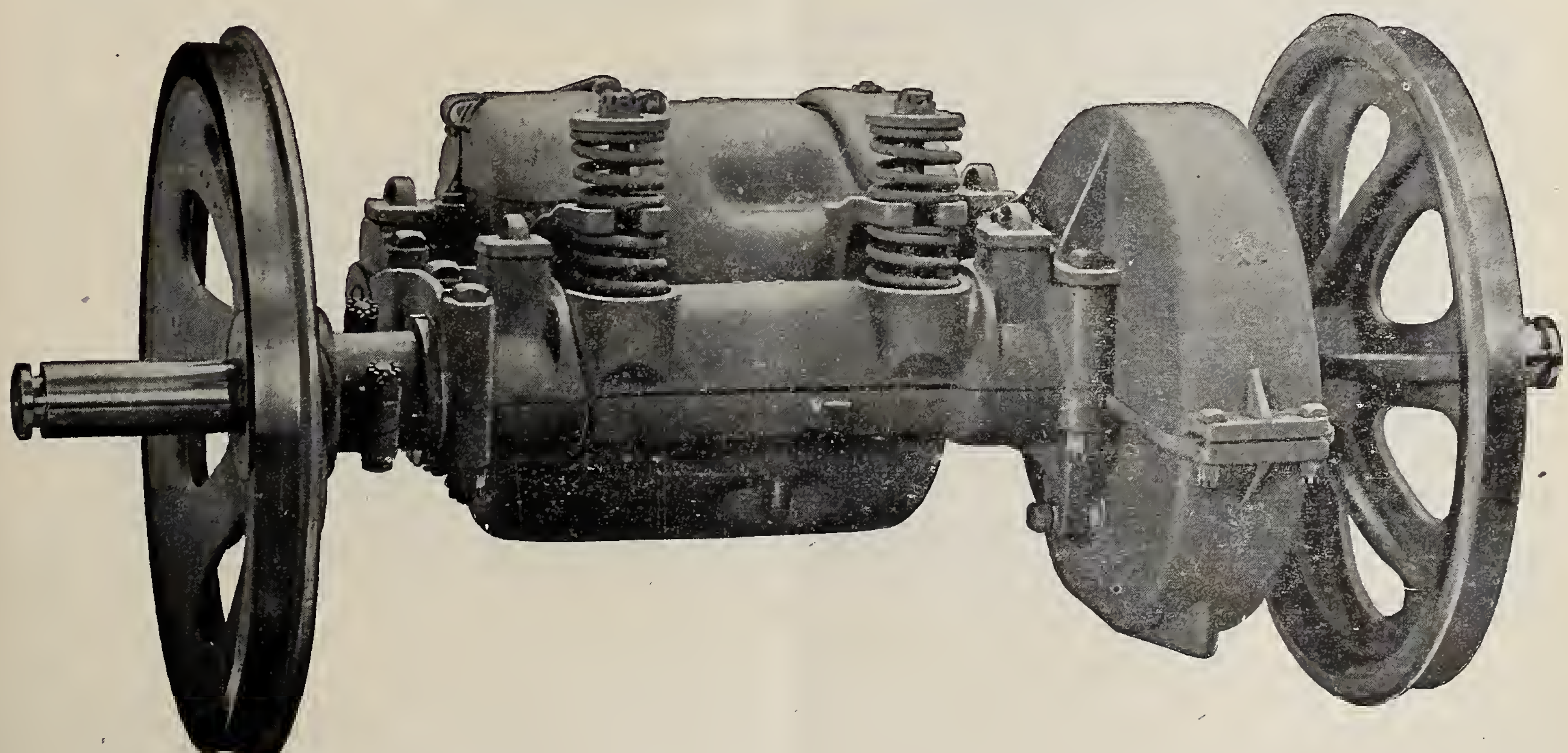
Fig. 15

THE WALKER COMPANY.

The rapid headway being made by one of our leading manufacturers is a sign of the benefits ultimately derived from conscientious work. The Walker Co., of Cleveland, Ohio, pursuing their own peculiar policy of making a thing well or not at all, have achieved wonderful success and popularity with their apparatus in the United States. Their street-car equipments have always given good satisfaction, and the many testimonials received from traction companies testify to the excellence of their motors, controllers and generators.



Walker Generator.



Spring Mounted Walker Street Railway Motor.

In the accompanying sketches we give a general idea of the appearance of the apparatus they turn out.

The generators, with their high point of overload, remarkably good commutator and brush construction, rapid regulation and solidity of parts have received frequent eulogiums amongst railway managers.

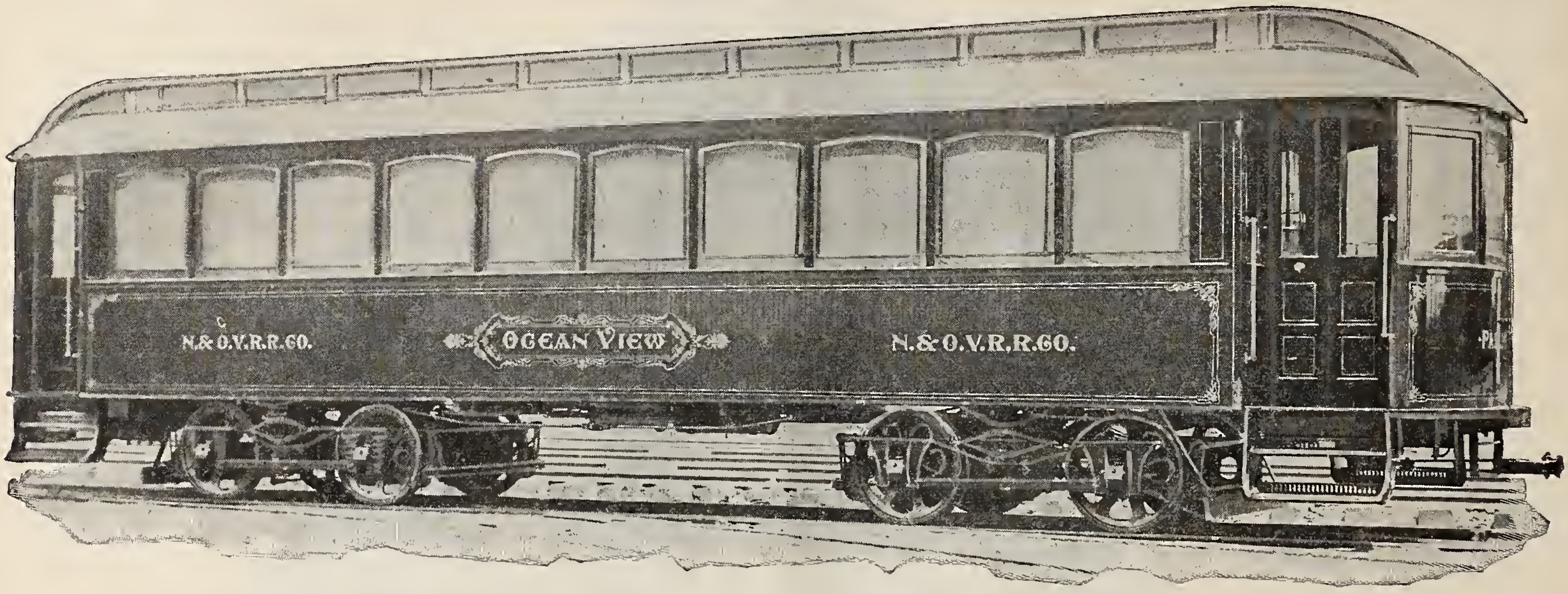
Their method of spring suspension on motor trucks has added a greater period of usefulness to the motor, better wear to the tracks and a saving in truck depreciation.

The rear view we give of the "spring-mounted steel-railway motor" will enable the reader to note the means taken to protect the motor and gears; also the springs as mounted on the motor with the motor on car axle. The blow is greatly reduced and, as enumerated above, the cost of such are injurious factors that require elimination.

Some of the cars equipped with the Walker apparatus are illustrated in these pages.

One of them, a suburban trolley car filled with attentive passengers, of the Mt. Clemens and Lakeside Traction Co.; the other, a long parlor car of conventional and familiar appearance that belongs to the Norfolk and Ocean View Railroad Co., of Norfolk, Va.

Some of the letters received by the Walker Co. speak of a continuous run of 48 hours of one of their generators while under heavy service, without sparking or heating.



H. & O. V. R. R. Co., Using Walker Car Equipments.

The Brooklyn Bridge is lit by current from Walker generators and according to the engineer, Mr. Martin, are giving perfect satisfaction.

The self-oiling device, the room for radiation of heat and the proper cross-section and wearing surface to commutator and brush have made the Walker generator capable of standing the greatest strains of daily practice. For either power or lighting they are satisfactory from every standpoint and have gained a place amongst America's leading types of electrical machinery.

Mt. Clemens and Lakeside Traction Co., Equipped With Walker Motors.

Buckingham, Que.—Ross Bros. will place an electric light plant in their new saw-mill.

THE ST. LOUIS CONVENTION.

The fifteenth regular annual meeting of the American Street Railway Association takes place Monday, October 20, 1896, in the Republican Convention Hall, St. Louis, Mo., and extends over a period of three days. The officers of the association are H. M. Littell, president Atlantic Avenue Railroad Co., Brooklyn, N. Y., president of the Street Railway Association; also vice-president and general manager of the Metropolitan Street Railway Co., N. Y.

Granville C. Cunningham, manager Montreal Street Railway Co., Montreal, Can., 1st vice-president.

Wm. H. Jackson, president Nashville Street Railway Co., Nashville, Tenn., 2d vice-president.

J. Willard Morgan, president Camden, Gloucester and Woodbury Railroad Co., Camden, N. J , 3d vice-president.

H. M. Littell.

T. C. Penington, treasurer Chicago City Railway Co., Chicago, Ill., secretary and treasurer.

Executive Committee—Joel Hurt, president Atlanta Consolidated Street Railway Co., Atlanta, Ga.; Prentiss Cummings, vice-president West End Railway Co., Boston, Mass.; C. G. Goodrich, vice-president Twin Cities Rapid Transit Co., St. Paul, Minn.; A. Markle, general manager Lehigh Traction Co., Hazelton, Pa.; W. F. Kelley, general manager Columbus Street Railway Co., Columbus, Ohio.

The city of St. Louis is a beehive of electrical industries. It is a great railroad terminus and the centre of many shipping interests. Founded originally by French settlers, it still retains traces of their early handiwork in certain ineradicable features of civic life. The city is well lit by electricity and abounds in trolley roads. As a home for big enterprises it compares very favorably with the largest of eastern cities.

An air of solid and substantial prosperity pervades its business atmosphere. There is absent that sense of expansion, of undue and unsatisfactory dilation, which is so decided an element of many centres of trade. St. Louis receives and sells many millions of dollars' worth of electrical supplies every year. Her ratio of increase in this respect has been of unusual consequence the last few years.

Large power houses, lighting stations and many private installations call for and utilize the supplies sent in. The St. Louis and Suburban Railway have erected some fine machinery in their power house at De Hodiamont. One of the greatest electric light stations in the world is within the city, supplying more than 90,000 incandescent lamps. The plants erected for the distribution of arc current and power are also of considerable size; the Municipal Arc Light and Power Co. being one of the greatest on the continent. As a centre of telephone and telegraph lines, as the seat of thriving industries, St. Louis is known throughout the United States.

It feeds the hungry from its immense granaries and pours untold bottles of amber fluid down myriads of thirsty throats.

The great breweries of the West are situated in and around St. Louis. All of these industrial growths, which embellish and add to the progress and wealth of a town, are supplied with electric lighting appliances.

There is in St. Louis a desire on the part of its representatives to further electrical interests, and we may well say that in it are found some of the greatest in the country.

At one time the cable car was in popular use; the rapidity with which a change was made to the trolley was astonishing. The cable station is now a landmark, as silent as it was once noisy. At Florissant, the point at which the St. Louis and suburban terminates, another power station exists.

The cars are of the St. Louis Co.'s construction, equipped with two 15 H.-P. T. H. motors.

The Lindell Railway Co. have a well designed power station. Its miles of track large and feeding system is excellent.

The power station is at the corner of Compton avenue and Dennis street.

The Benton and Bellefontaine Railway and the Missouri Electric Railway, and several other companies, have changed from older systems to the newer and better electric road.

The Lindell, Southern and Missouri Co.'s power houses are as much features to be visited as the city hall. At present there are many hundred miles of track in use and as much and more of trolley wires. At least 100,000,000 passengers have been carried annually by these roads and the number is increasing. There is no doubt but that the

centre of such great railroad interests will consider the event of a convention a matter of the greatest importance. A few years ago these municipal conveniences were unknown; today no investment promises greater returns and so meets with public favor as the electric car.

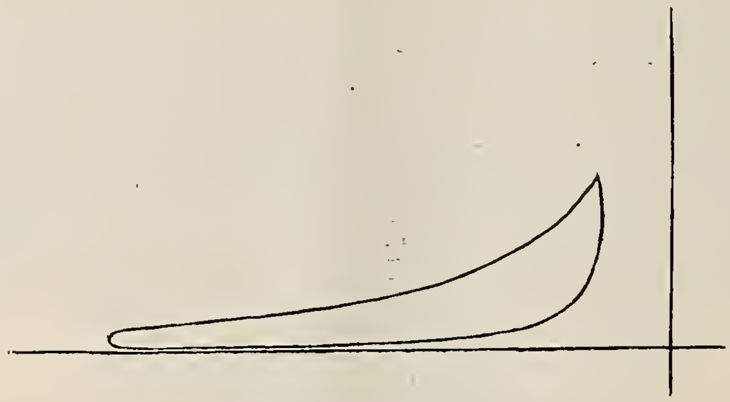
THE CLIMAX GAS ENGINE.

(A Gas Engine for Electric Lighting.)

In the history of electric lighting no problem has offered more inducements by its solution than that of transforming the energy of illuminating gas into electricity. In olden times the transmutation of metals occupied the alchemists' attention; to-day, the more modern mind is busily engaged with the transformation of power.

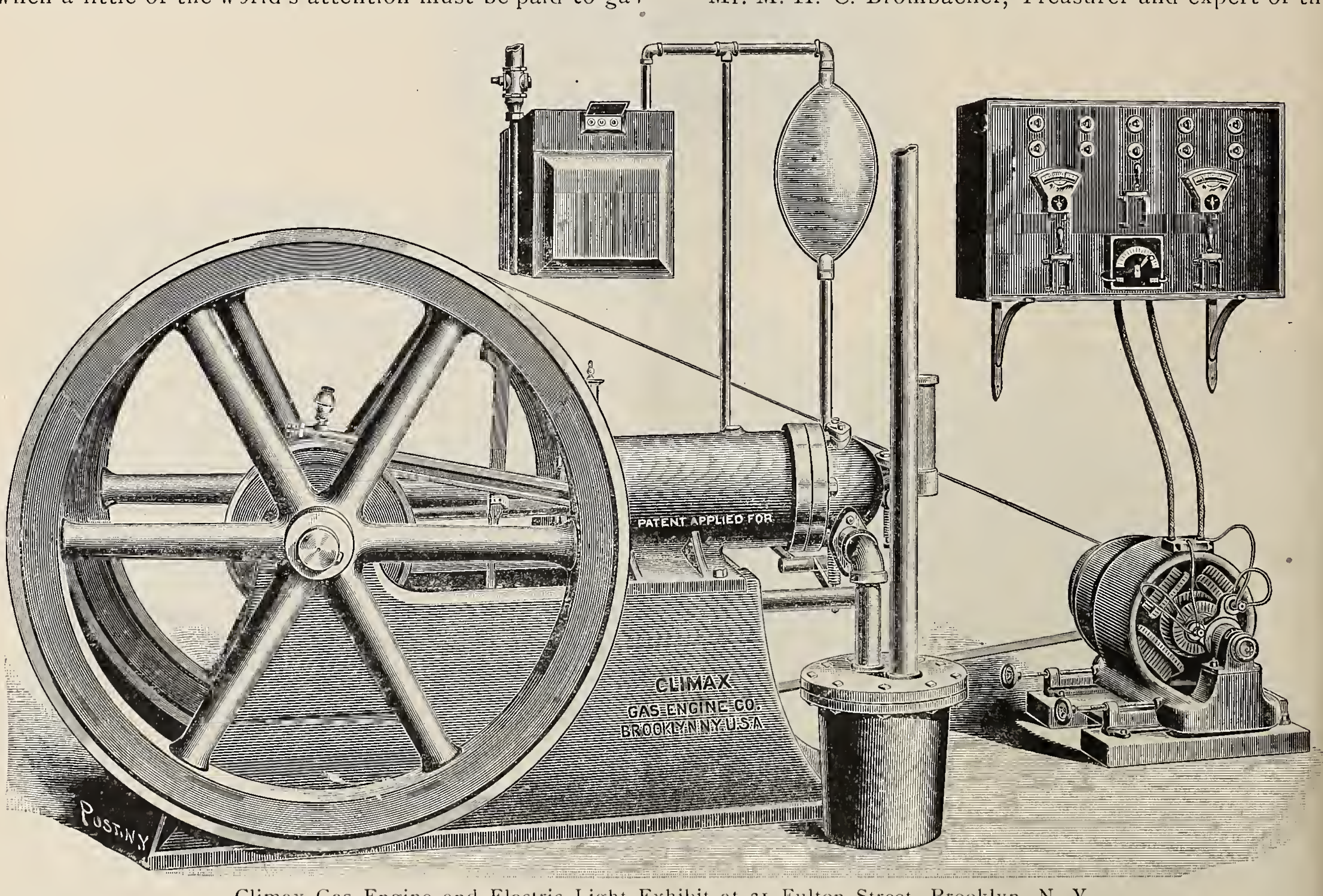
The steam-engine has reached a point of perfection beyond which it is difficult to go, but the time has arrived when a little of the world's attention must be paid to gas-engines, which in economy and regulation are now superior rivals.

The Climax Gas Engine Co., of No. 31 Fulton street, Brooklyn, have on exhibition a gas-engine which will meet the demands of practice in every respect. Many claims have been set forth by gas-engine manufacturers regarding the behavior of their apparatus, gas consumption, etc., under working conditions. The writer made a series of personal visits to the leading manufacturers in New York City in order that he might test the veracity of their claims by a personal test with voltmeter and ammeter, and by obtaining a record of the gas meter during the operation. It might be of benefit to the reader to know, in connection with this fact, that the regulation and gas consumption are of the greatest importance. The variation in volts during the test with different loads, and the cubic feet of gas consumed per hour with a given number of lamps; will lay bare the usefulness or failure of the engine for the purpose of electric lighting. The visits to the different companies were very unsuccessful. No other company exhibited voltmeter, ammeter and gas meter in full view with running plant and full number of lights.



Indicator Card of Climax Gas Engine.

Mr. M. H. C. Brombacher, Treasurer and expert of the Climax Gas-EngineCo., allowed the representative of "The Electrical Age" to make a test of their engine, the circumstances being as follows: the ammeter and voltmeter owned by the "Electrical Age" were new Weston station



Climax Gas Engine and Electric Light Exhibit at 31 Fulton Street, Brooklyn, N. Y.

instruments. *The gas-engine exhibited* was driving an Excelsior dynamo directly by belt, distance between centre of gas-engine shaft and dynamo shaft being about 8 feet 6 inches. The engine was designed to give an explosion every second revolution; being of the four cycle type with balance disks on the crank shaft. Its cylinder was 7 inches in diameter; its stroke, 13 inches; the piston speed, 598 feet per minute. With a mean effective pressure of 70 pounds to the square inch it developed 12.2 indicated horse-power. The above indicator diagram shows the action of the engine when supplied with Brooklyn illuminating gas and running at a speed of 276 revolutions per minute. The dynamo was of the Excelsior Electric Co's make; a four-pole machine designed by Churchward. Its capacity was 5.6 K. W.; its speed, 1260 revolutions per minute. The load it carried varied during the test, being composed of both arc and 3½-watt incandescent lamps, and was determined from the Weston instruments spoken of. The pressure in volts, current in amperes and gas consumption in cubic feet per hour were taken as stated in the following report:

Test of Climax Gas-Engine.

Full Load.

Speed of gas-engine, 260 revolutions per minute.
Cubic feet of gas, 171 per hour.
Volts, 108.
Amperes, 37.
Watts delivered per hour, 3,961.
Cubic feet of gas per K.W. hour, 43.

Half Load.

Speed of gas-engine, 260 revolutions per minute.
Cubic feet of gas, 144 per hour.
Volts, 110.
Amperes, 20.
Watts delivered per hour, 2,200.
Cubic feet of gas per K.W. hour, 65.

Quarter Load.

Speed of gas-engine, 262 revolutions per minute.
Cubic feet of gas, 106 per hour.
Volts, 110.
Amperes, 10.
Watts delivered per hour, 1,100.
Cubic feet of gas per K.W. hour, 96.

No Load.

Speed of gas-engine, 264 revolutions per minute.
Cubic feet of gas, 34 per hour.
Volts, 110.
Amperes, ½ (pilot lamp).
Watts delivered per hour, 55.

The last test shows the gas consumption of 34 cubic feet per hour. This represents the friction of both dynamo and engine, current for the fields, heat losses in dynamo and engine, etc., including the 55 watts for a pilot lamp. With this size dynamo the cost of running at no load would be 4¼ cents per hour on the basis of $1.25 a thousand cubic feet.

$$\text{At \$1.25 a thousand, 1 cubic foot} = \frac{1.25}{1000} = \$.00125$$

At $1.25 a thousand, 34 cubic feet = $.0425.

On this basis:

Full load – – – 43 cubic feet, cost $.05⅜ per hour.
Half load – – – 65 cubic feet, cost .08⅛ per hour.
Quarter load – – 96 cubic feet, cost .12 per hour.

The variation in speed of the engine was between one and four revolutions per minute. At full load the speed was 260 revolutions, increasing to 264 per minute at no load.

The voltage fluctuation did not exceed two volts with the load steady. The arc lamps in circuit by their occasional flickering (due entirely to deficiencies within themselves, as hard spots in the carbon, etc.), affected the readings slightly, so that with a perfectly steady load the voltage variation would be still further diminished.

The above report clearly shows that the claims made by the Climax Gas Engine Co. that, at full load, the gas consumption does not exceed fifty cubic feet per K.W. hour are fully substantiated; only 43 cubic feet per K.W. hour being consumed. The voltage regulation is likewise correct according to the test. The data concerning the engines is as follows.

Engines, Nos.	1 B.	2 B.	3 B.	4 B.	5 B.	6 B.	7 B.	8 B.	9 B.
No. of I. H. P.	2	3½	5½	9	13	18	25	35	50
No. of Revolutions.	300	300	300	280	260	240	240	220	220
Pulleys on Engine.	10x5	12x6	14x7	18x9	24x12	28x14	32x16	36x18	48x24"

The Climax Gas Engine Co. are ready to deliver at once engines of nine, thirteen and thirty-five H.-P. The remarkably good results they have obtained have led them to offer the electrical fraternity engines for direct connection either to railroad or light generators. The demands of the Fire Underwriters that both volt and ammeter shall be used in any lighting plant in full view are, of course, complied with in this case as they should in every other. (Frequently they are not, as a visit to gas-engine plants will quickly demonstrate.)

A large search light will be erected on top of the building at No. 31 Fulton street, supplied with current from the Climax plant. The steadiness and reliability of this engine are prominent features that, along with its economy, will appeal to any mind.

At full load the efficiency of the engine was estimated at twelve per cent. As this is but a small plant the efficiency would naturally increase with a heavier installation. In the full load test the watts produced were 3,961; with 3½ watt lamps, 1,131 c.-p. would be developed, and the 171 cubic feet consumed per hour would give with five-feet burners of 20 c.-p. only 684 c.-p. The gain is therefore almost two to one, and the cost of light on this basis correspondingly reduced. The public are welcome to visit this plant and see the results that have been obtained by the Climax Gas Engine Co.

Pressure of the Air.—We know, because we can ascertain directly, that 30 cubic inches of mercury weigh close upon 15 pounds avoirdupois, and therefore we say that, under normal conditions, the pressure of the atmosphere is 15 pounds on every square inch. If, however, instead of taking such a tiny space as a square inch for our base, we adopt some larger area, the facts at once begin to assume gigantic proportions. Thus, on a square foot the weight of the air is little short of a ton; on a square yard it exceeds 8½ tons; and on a square of 10¼ feet side it is 100 tons. What is known as Inner Loudon, an area of 122 square miles, supports an ærial pressure of 3,250,000,000 tons, or considerably over 600 tons to each inhabitant. To arrive at some approximate conception of the immensity of such a weight, we will assume the air over our islands to be converted into coal in the bowels of the earth. Our coal fields now yield about 180,000,000 tons of coal annually and give employment to 600,000 workmen. To bring to the surface the whole of the air which we have supposed turned into coal would occupy this vast army of miners a matter of 8,000 years.—Longman's Magazine.

Apergy.—Apergy is the name of the "force" claimed for the Keeley motor. It is thus defined: "It is obtained by simply blending negative and positive electricity with electricity of the third element or state, and by charging a body sufficiently with this fluid, gravitation is partly reversed, and the earth repels the body with the same or greater power than that with which it formerly attracted it, so that it may be caused to move away into space."—Progress of the World.

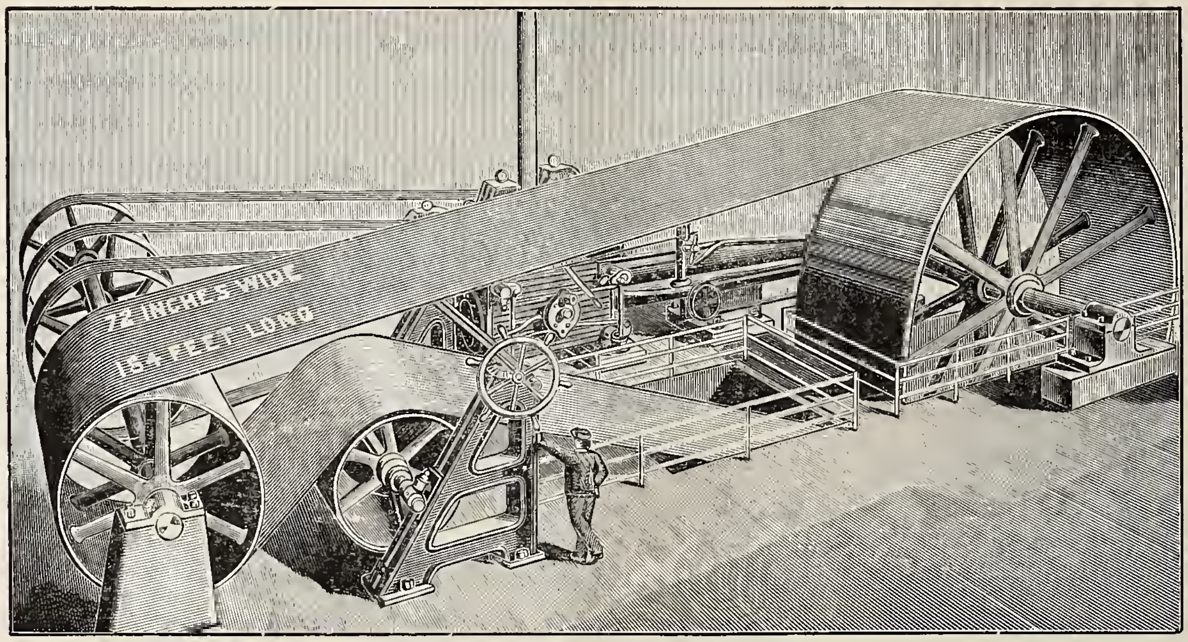
SHULTZ BELTING CO.

The Shultz Belting Co. have been so well known to the trade for years that their services are practically indispensable.

J. A. J. Shultz.

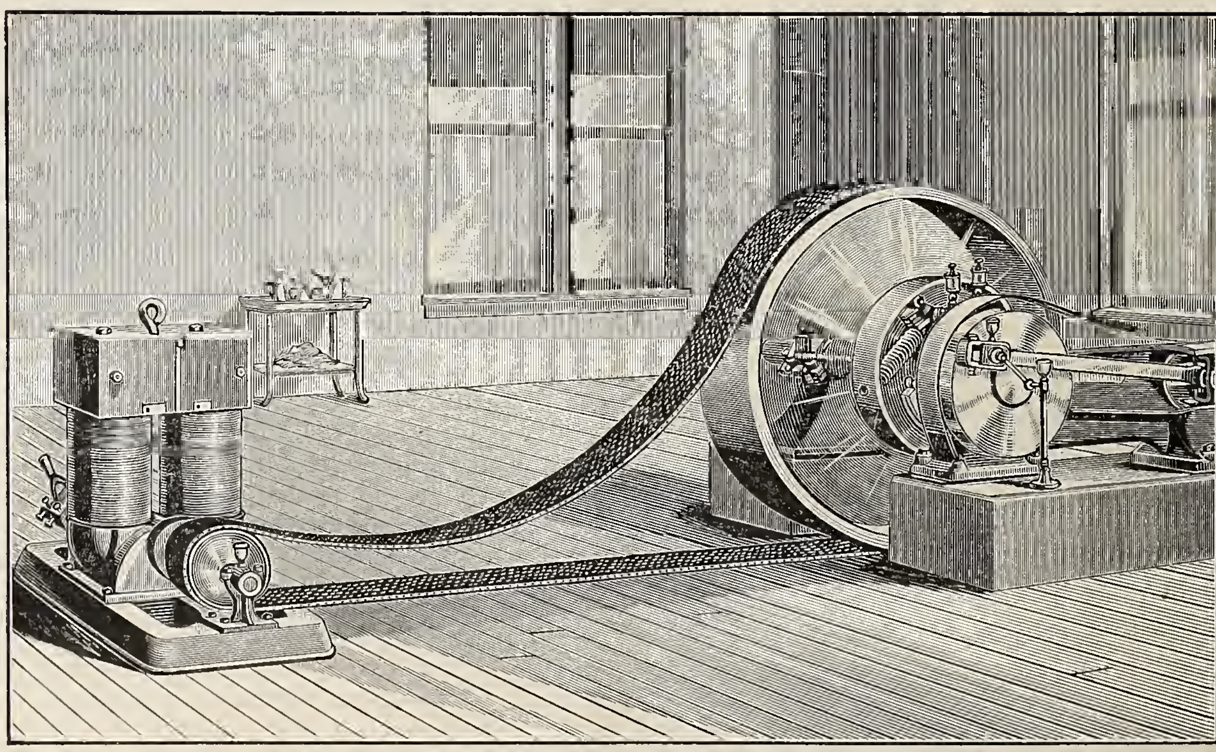
Among all the articles used in the various factories in all lines of trade, there is probably not one that creates more general interest or performs more important duties than that of belting. No factory can be carried on without its use, and it is of the greatest importance in every case that the most perfect form of belting should be secured. It is only by using the best belting that the machinery of the factory can be utilized to its fullest capacity; and if inferior belting is employed it immediately causes a considerable loss of power and time, and entails a series of evils that must necessarily result in a financial loss. Considerations of this importance have stimulated those in the business to produce a belting that would fulfil all the necessary requirements, and that would possess none of the disadvantages that have been found in the ordinary oak-tanned belting. This most desirable result has been definitely accomplished by the Shultz process.

A. B. Laurence.



Shultz Belt in St. Louis and Suburban R. R. Co.'s Plant.

One great set of reasons why the Shultz belting has succeeded so well is because it transmits one-third more power than other belts. It can be run slacker and is more pliable than others, and the effect of the atmosphere and stretching is the least possible.

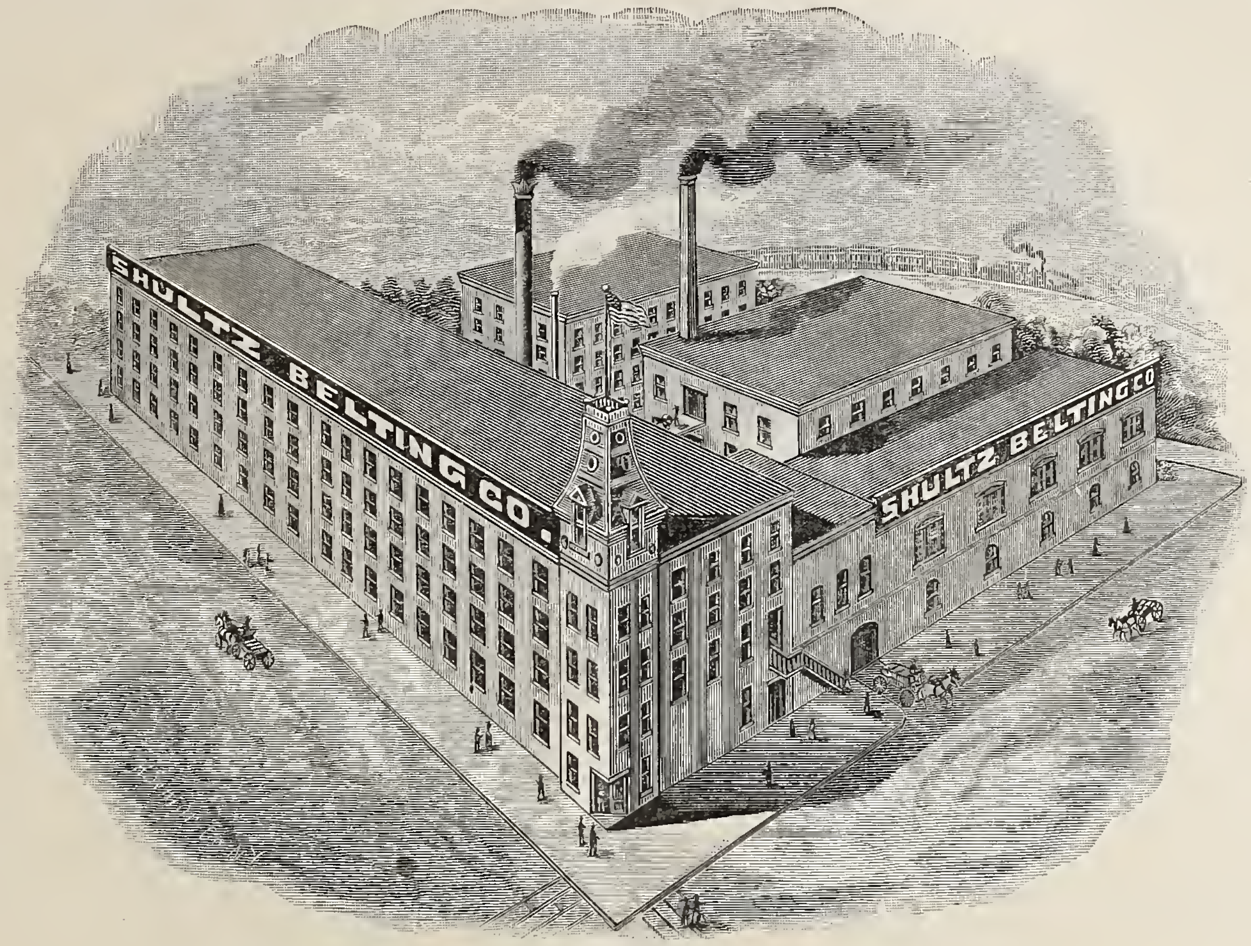


Shultz Belt in St. Louis Electric Power Co.'s Plant.

The grain is soft and something like kid, which causes it to adhere to the pulley—this, combined with its great strength and pliability, gives it its wonderful driving power, and hence no lost motion. On account of its softness and pliability it is especially adapted in places where belts have to run over small pulleys at high speed, and where they have to run on a twist. It has no equal where there is hard service and great strain, and for main drive belts on engines it will outwear any other belting made.

All this belting is carefully put together, of selected stock, is stretched twice before it is made into belts, and is guaranteed short lap.

Their belting has now been in use sixteen years all over the United States and Europe and has proved to be all they claim for it.



Works of Shultz Belting Co., St. Louis, Mo.

ELECTRIC WELDING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

One of the most familiar effects of our electric current is the production of heat. The light of the incandescent lamp depends upon the heat localized for its degree of brilliancy. The arc lamp only reaches a point of sun-like brightness when the heat of the arc intensifies with an increased current. The production of heat in an electric circuit can be controlled and reduced to be either imperceptible or too great to bear with hand or eye.

In any electric circuit the heat evolved is calculated by the rule—

$$\text{Heat} = C \times C \times R = \text{watts}.$$

Thus the power consumed in producing heat in a circuit having

Resistance = 10 ohms.
Current = 10 amperes.

$$\text{Watts} = 10 \times 10 \times 10 = 1{,}000.$$

An amount of energy exceeding one horse-power would be absorbed under these conditions.

To apply sufficient heat to a piece of metal to melt it requires current dependent upon its resistance. The greatest heat we have had actual experience with, is that of the electric arc. All the metals, oxides, quartz and granite formations become volatilized in it.

Carbon becomes a plastic mass; the diamond, a bit of ash.

Welding by electricity depends entirely upon the heat produced by the imperfect contact between two pieces of metal. The resistance of the joint causes the heat to localize itself there until the ends in contact become semi-liquefied and ready for permanent junction.

Steel, copper and iron are generally employed for the illustration of this process. The current used is alternating, being transformed down to a few volts when used.

The Thomson Electric Welding Co. have completed machines for practical use which will weld pieces of metal of given cross-section.

One size of welder will successfully join pieces of three square inches in cross-section; the smaller size can weld 1.2 square inches; also welders for the joining of pipe six inches in diameter are manufactured.

The objects in view when welding is attempted should be

Sufficient pressure at joint.
Sufficient current.
No oxidation.

The current used for the purpose is generated in an alternator at about 300 volts pressure; it is then transformed down to from 3 to 12 volts, according to the nature of the work to be done.

Many experiments have proven an alternating current the best for welding purposes. The positive pole of an attempted weld with continuous current would be very much hotter then the negative. This would seriously interfere with the weld, while if an alternating current be used the current heats each end equally. If a slight oxidation occurs at the joint, the weld may bind at the edges but be perfectly insecure inside. The instant the heat has arrived at the right point, the two bars of metal must be pressed together as forcibly as possible. This creates a burr on the outside which may be hammered down flush with the rest or removed in the lathe. The resulting surface should be smooth, unseamed and con-

tinuous when finished, without any signs of the juncture visible.

When steel is welded it sometimes happens that a black, burnt-looking mass forms at the welded point. This is caused by overheating, which drives out the carbon and changes the nature of the metal.

It can be restored by resting in a bed of red charcoal until carbon has been re-absorbed.

If a pail filled with a solution of soda or sal ammoniac and water have a metal plate connected to an insulated wire placed at the bottom, any piece of metal connected to another wire will, when dipped, become rapidly white hot *in the water;* the two wires being connected to a source of current. If one wire is disconnected, the same water serves to cool the metal instead.

Blacksmiths in the neighborhood of Niagara Falls use current from the trolley roads for this purpose, their forge consisting of a pail of water and a pair of insulated tongs.

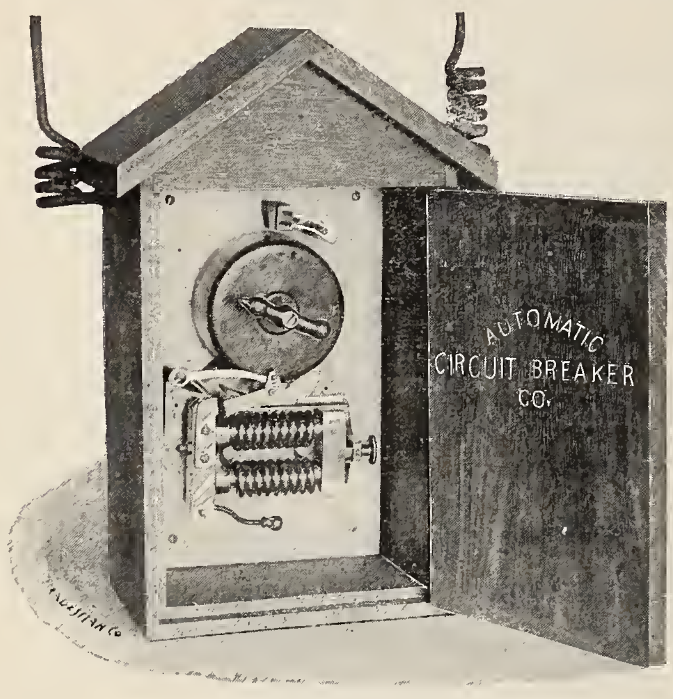
For purposes of forging, the following figures are given for an 80-lb bar measuring 1 × 8 × 36 inches.*

Cost of heating by coal	$1.25
" " " " electricity	0.78
Saving - -	$0.47

The advantages of an electric forge are therefore not merely those of convenience alone, but be to figured in dollars and cents.

*(Electricity at World's Columbian Exposition.)

Section Circuit Breaker.—The device shown is what street railway managers have all been looking for—an



Newaygo Automatic Circuit Breaker.

"Automatic Section Circuit Breaker," one easily installed and once in position worth its weight in gold; divide your feeders and trolley lines into as many section as convenient for you, and protect each section by one of our instruments. Each section is independent; short circuit on one line does not delay your entire system. Order one; we feel confident of the result; you will equip your entire lines with them. This device is one of our leaders.

In case of any accident occurring and circuit breaker acts, it also opens the door automatically. No fuses to replace; circuit closed as easily as with a knife switch.

Will furnish all of their appliances on 30 days' trial.

Exhibited at St. Louis by Elmer P. Morris.

TELEPHONE NOTES.

Albany, N. Y.—The Hudson River Telephone Company is about to establish a branch exchange on Quail street, for the use of subscribers in the western part of the city.

Philadelphia, Pa.—The Delaware and Atlantic Telegraph and Telephone Company has applied for permission to open trenches and lay conduits in Wilmington.

The Government has begun work in laying the new telephone cable between Longport and Ocean City, to have the life-saving stations at these points in communication. The line will be continued to Cape May.

BUSINESS NOTICE.

Phillips Insulated Wire Co. have given up their New York office and all business in future will be conducted direct from their general office and factory at Pawtucket, R. I.

The officers of this company are H. C. Adams, president; H. O. Phillips, treasurer and general manager, and H. C. Adams, Jr., secretary.

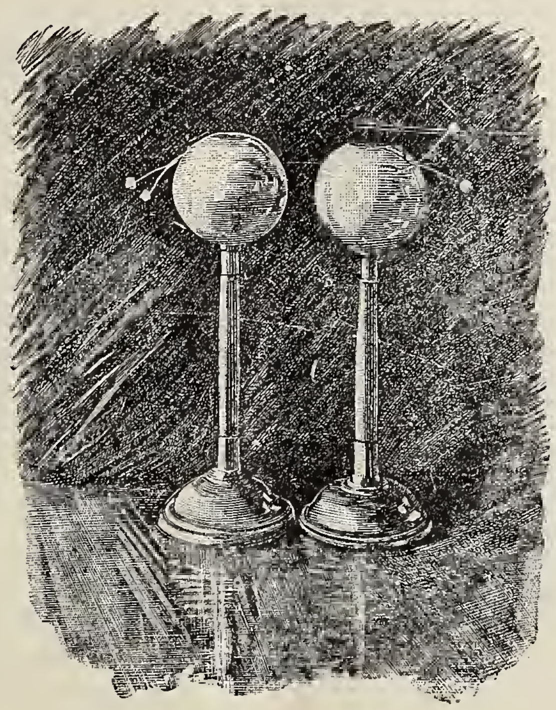
PERSONAL.

Mr. H. C. Adams, Jr., having been elected secretary of the Phillips Insulated Wire Co., will hereafter make his headquarters at Pawtucket, R. I., and their New York office at 39 Cortlandt street will be closed.

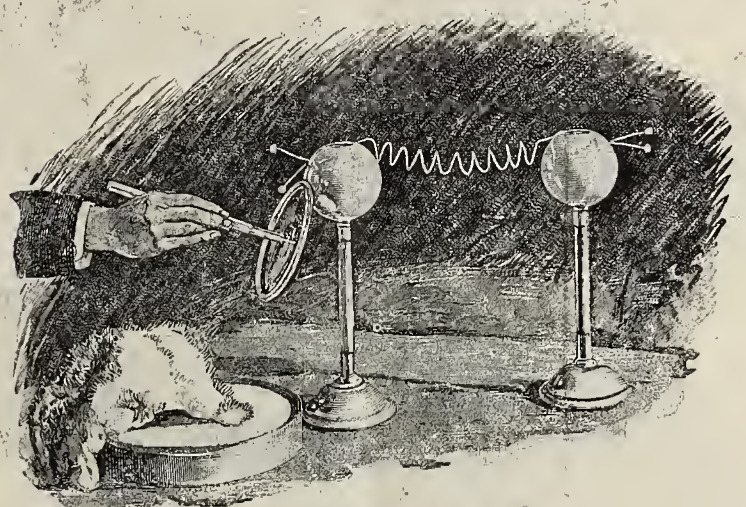
Mr. Adams will have charge of the sales department and will visit the trade as heretofore.

The Electrical Age.

VOL. XVIII., No. 17. NEW YORK, OCTOBER 24, 1896. WHOLE No. 493



Static Induction.



The Conduction of a Charge.

PRINCIPLES OF STATIC ELECTRICITY.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

INTRODUCTION.

Static and Dynamic Electricity. For purposes of convenience it has been best to classify electrial phenomena under two headings—

Static electricity,
Dynamic electricity.

When electricity is produced it may either be in a state of motion or rest. The friction of rubber upon flannel arouses in the rubber a stationary charge of electricity. It is not like the current from a battery, because it remains at the place where it was generated.

Frictional or static electricity, therefore, is electricity at rest, and the moving flow of electrical energy from a battery is dynamic electricity or electricity in motion. The peculiar difference existing between static and dynamic electricity may be always considered as due to the freedom of motion one possesses over the other. There is also another great difference, which is, that a static charge has many thousand times more *pressure* than a battery current, but the battery has in turn an enormously greater flow of current so that it seems frictional electricity means a high potential charge and dynamic or current electricity a low potential flow. A great pressure and little current in one case and a large current and

little pressure in the other case. When a pressure of millions of volts delivers upon discharge a powerful current, there is then the striking power of a static charge added to the heating and burning properties of a heavy current; in other words, all the effects of lightning may under these conditions be imitated; these being in fact the requirements of a dangerous flash resulting from surcharged clouds.

This explanation of the difference between static and dynamic electricity will keep the mind clear regarding the special applications to which each may be put in practical life, and will in addition serve as an introduction to a little of the history and early experiments of its devoted followers.

* * * * * * *

Before the new era of Christianity had dawned, and possibly even in the days of Joseph in Egypt, amber beads formed an article of barbaric ornamentation. Amongst the thousands that wore these polished tokens of prehistoric times one at least must have noticed the adhering particles of chaff and dust with sentiments of wonder. No records exist, however, to show an appreciation of the electrical properties of amber, but the Greeks spoke of it through one of their number, Thales, as a soul or spirit that manifested itself—amber being the tears of some sorrowing god; the attractive power it possessed a sign of its immortality and awakened animation.

A long stretch of time intervenes between Thales and Queen Elizabeth's reign in England. Dr. Gilbert, her court physician, unearthed the statement of Thales regarding amber and experimenting further discovered that glass, sealing-wax, sulphur, etc., would, when rubbed, also attract light substances to themselves like the amber.

Gilbert tried metals, but he did not know that the charge excited in them leaked away into his hand and body and prevented any attraction from being exhibited.

The additional fact not comprehended by him was that there are two great classes of bodies, generally speaking—one class, like sealing-wax and glass holding a charge; the other class, like the rods of metal he used, allowing it to pass away. In other words, bodies may be divided into the following:

Conductors,
Non-conductors.

Between the two may exist materials which do not allow electricity to pass very freely through them, yet are not insulators; they are called partial conductors—wet wood, earth or the human body being fair examples.

Positive and Negative Electricity.—A pith-ball supported from a silk thread is used for detecting a charge. If a rubbed glass rod is brought near it, the pith-ball flies to it, remains an instant and then leaves. If the glass rod was sufficiently charged, the pith-ball, after touching, would show the strongest repulsion for the rod.

The reason is simple; the pith-ball upon touching the rod becomes charged; the charge on the pith-ball and rod are then *alike;* this causes the repulsion, illustrating the law that

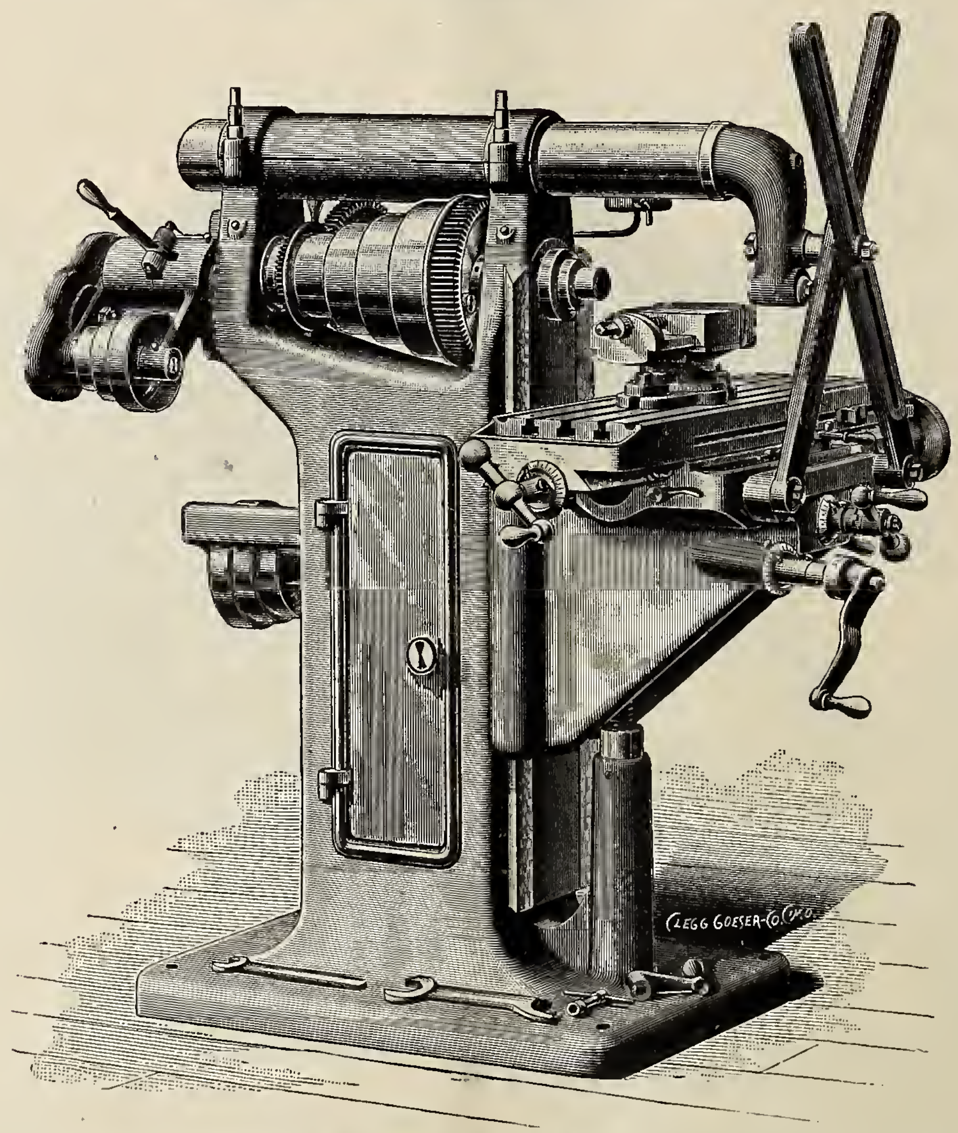
Like charges repel each other.

If a rod of sealing-wax is rubbed on flannel the pith-ball will behave in the same way towards it. Flying to it, resting and immediately leaving. The charge on the sealing-wax was communicated to the pith-ball as in the first case; *both* then repelled each other, and the pith-ball, being lightest, was thrown off.

If while the pith-ball is being repelled by the sealing-wax the glass rod is brought near, the pith-ball will be attracted to it. What the sealing-wax drives away the glass rod attracts.

If the opposite is tried (while the pith ball is being driven from the glass), it will be drawn towards the sealing-wax. The electricity on the glass and that on the wax act oppositely on the pith-ball. Their charges must be different; we call that on the glass *positive*, and that on the sealing-wax *negative*. The pith-ball, when full of *positive* from the *glass*, swings towards the *negative* on the *wax;* in other words,

Unlike charges attract each other.

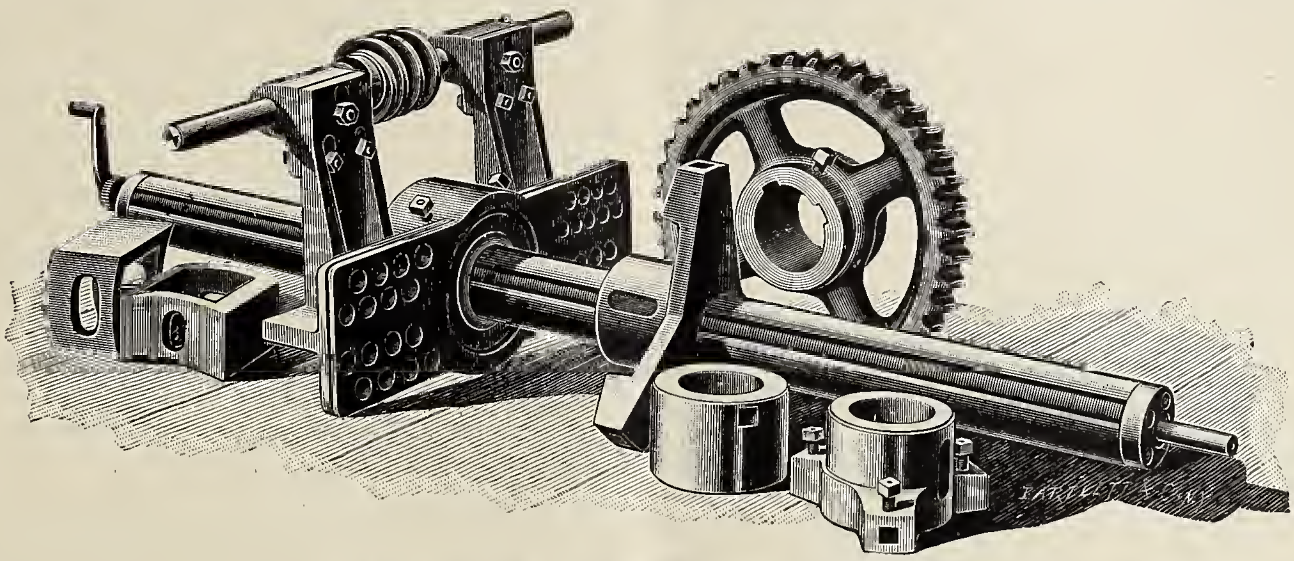


Plain Milling Machine.

CYLINDER BORING IN POSITION

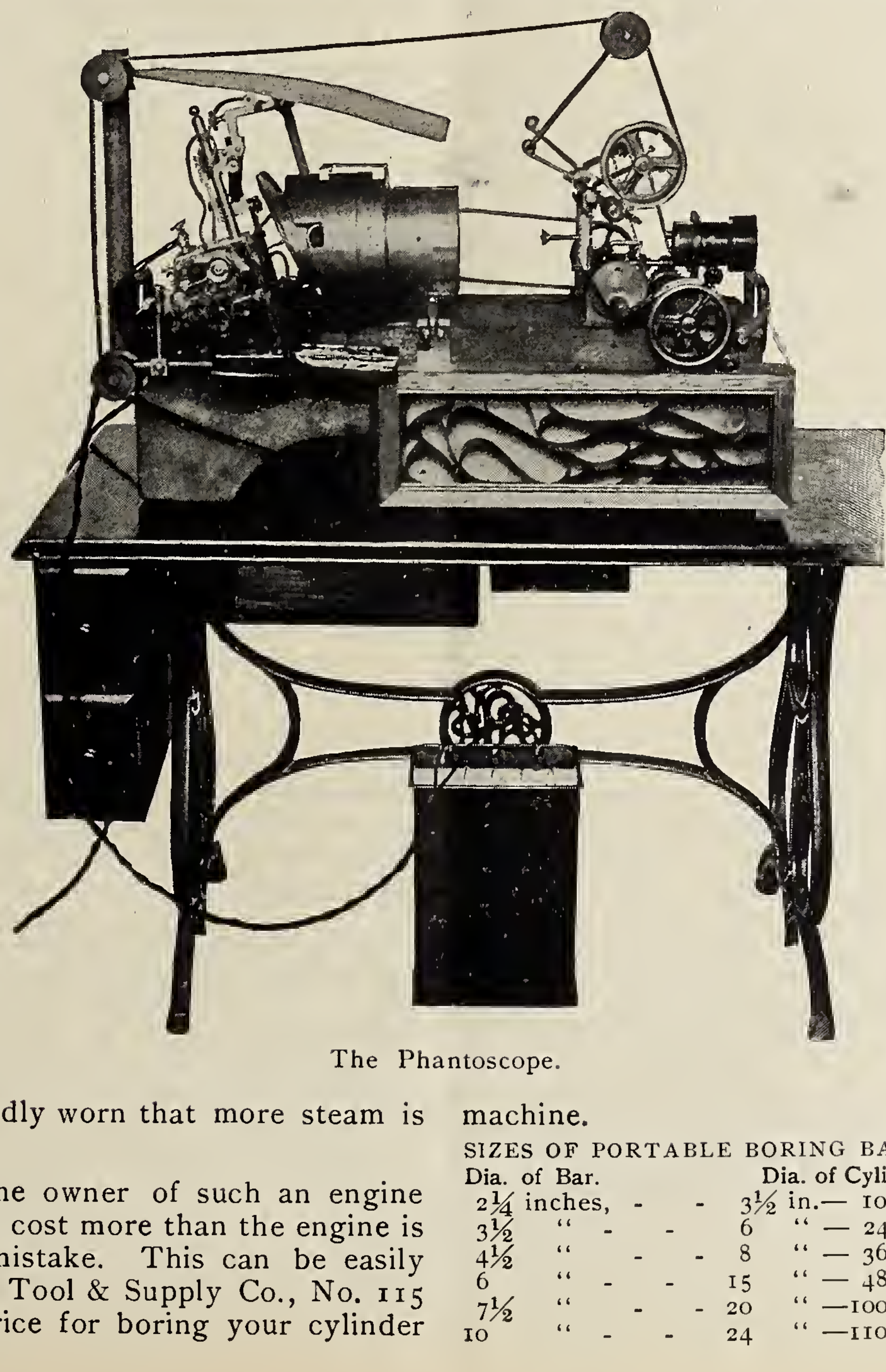
Has proven to be the only correct way of getting a smooth working piston, good results, and economy from the most important working part of a steam-engine. The cylinder bore in combination with the piston rings is as important to the proper working of an engine as the healthy action of the heart and lungs is to the human system. When these parts are not in perfect working order the engine works at once to a disadvantage in many ways. First, loss of steam and consequently loss of power; second, a slight loss on the vacuum, if a condenser is used, causing more work on the circulating pump and waste of water, etc. Nothwithstanding all the loss a leaky piston causes, there are thousands of them laboring along—some so badly worn that more steam is wasted than used.

There are cases where the owner of such an engine thinks boring a cylinder will cost more than the engine is worth, which is a great mistake. This can be easily proven by writing Prentiss Tool & Supply Co., No. 115 Liberty street, N. Y., for price for boring your cylinder and the length of time it will take to get the engine running. The reply, no doubt, will be encouraging. Then, again, there is another mistake made by some parties, which is, instead of having their cylinders rebored when they need it, they prefer buying new rings every few weeks or months, which will either break or wear out at once, while the trouble remains the same. Again, some people are led astray by concerns offering rings for sale which will "true up" the cylinder when out of round or oval. This may be so, but the writer never saw it done.



The Prentiss Dynamo and Cylinder Borer.

The Prentiss Tool & Supply Co. have bars for reboring disk-cranks, centre-cranks, taper holes, stern tubes, Corliss engine valve-chambers, piston valve-chambers, holes in large fly-wheels, wheel-flanges, and the fields of dynamos without transporting them, as the borer is a portable machine.



The Phantoscope.

SIZES OF PORTABLE BORING BARS FOR BORING IN POSITION.

Dia. of Bar.	Dia. of Cylinders.	Length of Travel.
2¼ inches,	3½ in.— 10 inches,	30 inches.
3½ "	6 " — 24 "	32 "
4½ "	8 " — 36 "	50 "
6 "	15 " — 48 "	62 "
7½ "	20 " —100 "	98 "
10 "	24 " —110 "	120 "

THE PHANTOSCOPE.

People have frequently remarked the possibility of combining the colors of life with the realism of motion as a feat of the greatest ingenuity. This idea has been the subject of careful study by Mr. C. Francis Jenkins, to whom the honor of perfecting an apparatus of this kind belongs. The phantoscope, as described by the opening words of the pamphlet, produces pictures "Beautiful as the visions of a dream; silent as the awakening of the dawn......" It owes its development to the plaything of olden days, the zoetrope; a revolving cylinder upon which the different poses of a completed movement are successively placed so that upon revolution one blends into the other uninterruptedly.

A powerful focussing lamp sends a strong light through a series of rapidly-shifting photographic transparencies. The pictures can be enlarged to the extent of twelve to eighteen feet square. The phantoscope consists of

(1) The motor.

(2) A small but powerful arc lamp requiring from 15 to 25 amperes.

(3) A condensing lens to gather and focus the rays of light from the lamp.

(4) An objective lens to project the views.

(5) A device to rapidly move or feed the photographic films.

(6) The films, or views.

The current for the lamp is fed from a 110-volt current. The motive power for the mechanism is supplied from batteries.

With twelve films two changes would give an hour's entertainment, about one or two minutes only being required for the substitution. An endless film can be used, operated by an automatic device, which allows it to run as long as desired.

The following extract supplies another idea of value to the professional exhibitor: "Where desired, the phantoscope will be fitted with a graphophone attachment. What could be more delightful than listening to beautiful music while these marvellous, moving pictures, radiant with exquisite colors, are opening to your astonished vision."

This completed outfit is sold by the Columbia Phonograph Co., No. 1159 Broadway, N. Y.

THE DAILY INSPECTION AND CARE OF CAR EQUIPMENTS.

BY JAMES B. CAHOON.

In carrying out a system of daily inspection, or any system for the care of car equipments, we have in view a two-fold object.

1st. To prevent break-downs when the car is out on the road, and the consequent annoyance to passengers, as well as the blocking of traffic and the throwing of the cars off their schedule time.

2nd. The reduction to a minimum of the repairs necessary to maintain the equipments in good working order and the prolongation of their life. We have, then, to determine how we can best accomplish these objects and in so doing obtain the best results with the least expense.

Considering for a moment what we have to deal with, we find in the ordinary electrical car that we have two motors of fifteen-horse power or upwards, with their various connections, placed in the very worst possible position in which to operate machinery in motion, exposed as they are to heavy clouds of dust and dirt in the streets, with occasional sticks, stones, wires, etc., thrown into them; and on rainy days and in the winter time, to the throw of mud, slush, and water from the wheels, and subjected to wide fluctuations in the power which they must produce under these unfavorable conditions. If we were to suggest to a steam engineer the placing of a fine engine to do work under similar conditions and in a similar situation, the chances are that he would say that it was not only impossible but absurd to think of an engine working satisfactorily under such circumstances; yet in many respects the electric motor is quite similar to the steam-engine, as both have moving parts to be cleaned and properly lubricated, the motor having as its driving agent in the place of steam an electric current under comparatively high pressure, requiring certain parts to be carefully insulated, or rupture would occur which would disable the motor for the time being; in fact, a careful comparison between the two, part for part, would show that the motor is the more delicate of the two machines, and should, therefore, in order to secure successful operation, have more careful attention paid to it, and be subjected to a systematic course of inspection of all its parts from time to time.

In general there are three systems in vogue at the present time, the first being to let the motors take care of themselves until something gives out, and then it is replaced and such repairs made as seem necessary at that time. Second, and the one followed by many of the smaller roads, is, when the car comes in at night to have one or more men examine the boxes to see that they are filled with grease, rub off the commutator and see that the brushes are not too far gone for the next day's use, and if they are to replace them with new ones; examine the trolley wheel and see that that is in good shape and see that the brakes are repaired properly; then the car is washed or wiped on the outside and is ready for the next day's run. Following this, whenever a breakdown occurs, the car is run over the pit and given a thorough overhauling. The brasses, pinions and gears are examined and replaced, if deemed necessary, and the motor is painted if it so requires and put into fair shape; or, in some cases, it is taken down entirely and thoroughly overhauled.

The third system consists of a rigid daily inspection of the motors, trucks and car bodies in all their parts, everything being gone over by competent inspectors and the car not allowed to go out if any defects exist. This last system seems to be the only one by which we can hope to get perfectly satisfactory results, but it can be elaborated so that the expense would be more than the gain, though as a rule I have not found this to be the case. The system whose adoption I would advocate is that which we have put in practice on our road and suggested to some other roads, which, from actual experience, has shown itself to be an eminently satisfactory one. The system is as follows: a trip inspection, a daily inspection, and a monthly inspection. A trip inspection may be made in one or two ways; if the car runs into the car barns at the end of each trip it may be gone over by inspectors ready to receive it, who examine the boxes, see that there are no signs of heating, that the grease cups are properly filled, that the armature and fields are all right and that the brake mechanism is in proper condition. On small roads where cars are not run into the car barns, perhaps, until the end of the day, this inspection can be made by the motorman at the end of each trip, it being a brief one and can be made in a couple of minutes, and if anything is out of order the trouble can be remedied on the spot. To this end, as well as any repairs en route, each car should be provided with a tool bag containing a small ball pein hammer, a ten-inch monkey wrench, a pair of eight-inch pliers, and a ten-inch screw-driver.

The daily inspection: When cars are run into the car barns after the day's work is over, two inspectors board each car and go over every part of the car and equipment, removing dust and dirt from around armatures and fields as far as possible with a hand bellows, wiping commutator, removing brushes and seeing that they are in good order and the copper peeled back on them so they will not wear into the copper coating during the next day's run, thus

avoiding the squeak which this would cause. Every electrical connection is carefully examined to see that it has not become jarred loose, and if any defect exists in any part it is immediately repaired, if such repair will not involve ten minutes' work; if it does, then the car is left over for the machinists to put in order on the following day. The same care is exercised in going carefully over all the nuts, bolts and washers, cotter-pins, etc., connected with both motor and truck; brake rods are gone over and brake shoes examined and everything seen to be in proper working condition for the morrow. The car is then turned over to the car washer, who goes over the outside of the car cleaning all parts carefully, the inside of the car being swept out by the conductor who brings the car in, and the conductor who takes the car out in the morning cleans the brass work and windows and dusts off the seats and the inside of the car. In this manner we have caught a great many troubles just commencing which cost comparatively little to fix at that stage, but which, if allowed to continue, would have entailed quite serious outlay.

Third, monthly inspection: Once a month in rotation each car is run over the pit and motors dropped down, taken apart and thoroughly cleaned; gears, pinions and brasses, if they are so far worn that they will not last another month; are replaced. The armature and fields are carefully cleaned and painted and the commutator turned down if necessary; in fact, the equipment put into first-class order throughout, so that to all intents and purposes it is as good as new when again replaced on the car. The car-body and truck receive the same care and attention and are also put into first-class running condition.

We have found by experience that a shoe having sections of harder material cast in it has effected quite a reduction in the cost of brake shoes, the average life of these shoes being about three and a half times that of the ordinary cast iron shoe; these shoes lasting a little over two months on our road, while the old system cast iron shoe only lasted about fifteen days.

A comparison of figures on our own road of the two different plans of the careful system of inspection and the old way of letting things go until they go to pieces, shows that the saving effected more than equals the total wages of the men employed on inspection and the machinists employed in the daytime repairing the cars. This, however, would not hold true on a large road, probably, but certainly the saving effected would considerably more than offset the wages of the men on inspection alone, and I believe that a system such as outlined above will, if carefully followed out, accomplish the best results with the least expense.

STANDARDS OF LIGHT.

(Continued from page 604.)

A difference in the radiant efficiencies of the two sources of less than 0.2 per cent. would serve to bring this value down to 0.88. The preponderance of evidence in favor of thevalue of 0.88 is very great. It is probable that the very best way we have at the present time of determining candle power is to use the Hefner lamp and then to reduce by the use of this ratio.

1. See Part IV. of this report. The intensity of a Hefner lamp was determined by comparing it with the glow-lamp used throughout this investigation, the candle-power of which was, subsequently, accurately known from many measurements.
2. Vide supra.
3. This is the mean of a long series of determinations made by different observers at different times, using candles from various sources. The measurements were taken at normal flame height of 45 mm. See Beglaubigung der Hefner—1 lampe. Zeitschrift fur Instrumenterkunde 13 p. 257.
4. An abstract in German by Kruss will be found in the Journal fur Gasbeluchtung und Wasserversorgung. 1894.
5. Scheile. Report of committee on the comparison of the Hefner lamp and German and English candles. Journal fur Gasbeleuchtung und Wasserversorgung band 32. 1889. p. 757. Also Dingler's Polytechnisches Journal, 274, p. 540. The measurements were made at normal flame height of 45 mm.

X.

PLATINUM STANDARDS.

(1) *The Violle Standard.*[1] —Violle conducted a long series of experiments upon this radiation of silver and platinum raised to various temperatures, and investigated also the light emitted by these metals when, after being melted, they have just reached the point of solidification. For platinum he obtained by the use of the thermopile a curve of cooling.

This shows that molten platinum cools very rapidly at first, but as it nears its point of solidification its rate of cooling becomes much slower and, just upon solidification, there is a sudden rise in the intensity of radiation. After this the cooling goes on rapidly once more. Violle's proposition for a light standard is this : He would define the unit of light as the light radiated by one square centimetre of platinum at its point of solidification. He melted the platinum by the use of the oxyhydrogen blow-pipe. A hollow cylinder through which cold water is circulating and which is pierced by an aperture one square cm. in size is then passed above the molten metal. The light is reflected along the photometer bar, and its changes of intensity are followed by means of the photometer. The setting which is made at the time of the final increase in radiation (éclair) is the one which is taken as representing the intensity of the standard. From Violle's measurements a very good result was obtained for this standard. Unfortunately, however, he used the Carcel lamp as a comparison standard in much of his work, and the deviation of his various measurements of the intensity of the platinum standard may be due entirely to his comparison standard.

But few physicists have investigated this unit, the reason probably being that it is so expensive to install and difficult to operate. At the Reichsanstalt,[2] investigations have been made by Lummer and Kurlbaum, in which the platinum was melted by Violle's method, and also by the use of an electric current. Their definite results have not been published, but it has seemed advisable to them to abandon the use of the Violle standard as impracticable.

Many attempts have been made to substitute for the large mass of platinum which Violle used a thin strip, and to take measurements upon the platinum at its melting point rather than at its point of solidification. None of these have led to very favorable results. The best one probably is that proposed by Siemens. This has been carefully investigated at the Reichsanstalt. Hundreds of meltings were made, the greatest precautions being always employed, but the deviations were found to be as large as ten per cent. or more. The conclusion reached from this by Lummer and Kurlbaum is that thin platinum foil, when heated electrically, often tears apart long before the whole of the radiating surface has reached the melting point.

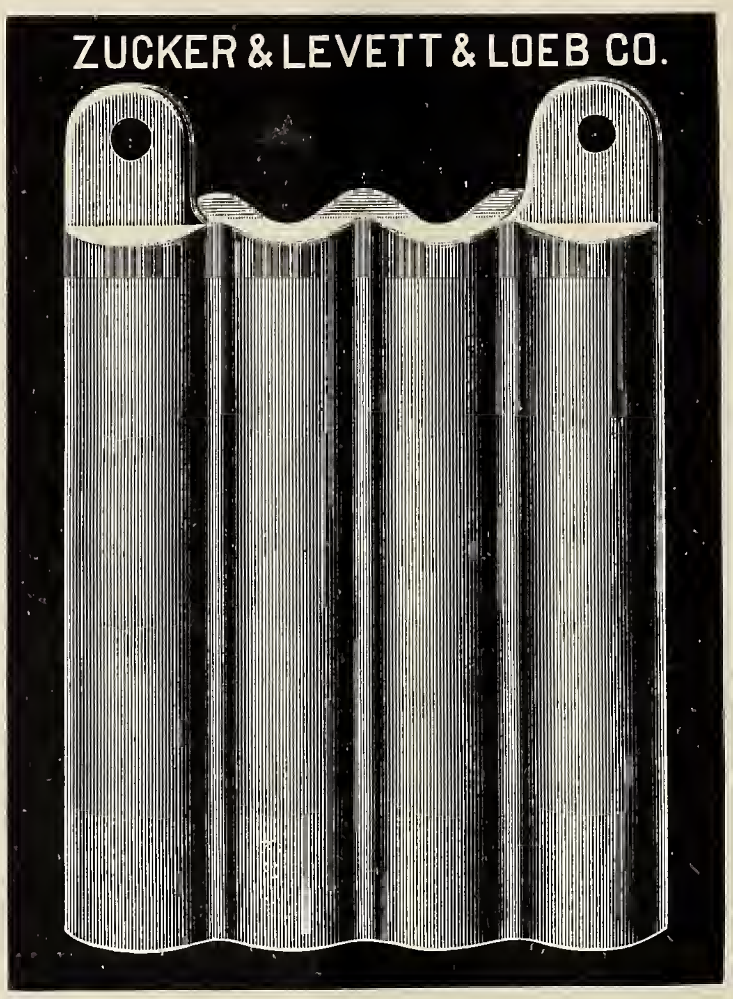
Mr. C. R. Cross[3] investigated the radiation from platinum wires of various diameters when brought to the melting point by the electric current, and came to the conclusion that the fusing point depended upon previous history of the platinum, the gas occluded, etc.

Draper, Schwenler and others have proposed, as a light standard, the light emitted from the surface of a platinum foil of definite dimensions when a given amount of electrical energy is being expended in it. None of these suggestions have led to any practical result.

(2) *The Lummer and Kurlbaum Platinum Unit.*—From their previous investigation of the Violle Siemens stand-

1. Violle, *Annales de Chem et de Phys.*, Ser. 6, vol. iii., p. 373.
2. Lummer and Kurlbaum, *Electrotech. Zeitschrift*, vol. xv, 1894, p. 474.
3. *La Lumiere Electrique*, 22, p. 507.
4. Lummer and Kurlbaum : *Elektrotechnische Zeitschrift*, vol. xv. (1894) p. 474.

ards, Lummer and Kurlbaum[4] concluded that absolutely pure platinum should be used as a radiating surface. They found that even a rough surface of the same became white when incandescent, and that moreover the platinum tended to purify itself when repeatedly heated and cooled. On the other hand it would seem that the fixed temperature could be neither the melting point nor the solidifying point of the platinum, so that a method of defining the temperature of an incandescent platinum surface was sought for. These observers appear to have reached the end sought, even though the light unit obtained has not entirely fulfilled their wishes in respect to simplicity. "It demands," they say, "a complicated arrangement of delicate apparatus, and great experimental skill." They define the unit of light as that emitted by one square centimetre of incandescent platinum when the ratio of the portion of its radiation transmitted by a specially designed water cell to its total radiation is equal to $\frac{1}{10}$. The platinum foil is stretched beneath a suitable covering arranged degree of constancy. In determining the radiant efficiency the throws of the galvanometer showing the total radiation, and radiations through the cell were taken with the bolometer at such distances from the platinum foil that the galvanometer throws would be equal in the two cases; that is, the distances were in the ratio of $1 : \sqrt{10}$. In this way any errors due to the peculiarities of the galvanometer used were eliminated. It was found that an error of one per cent. in determining the radiant efficiency corresponded to an error of three per cent. in the intensity of light. Investigation of the radiation from chemically pure and from commercial platinum foil showed a difference between them. At a high temperature the impurities of the commercial foil evaporate, so that the surface does not remain perfectly smooth, while the surface of the chemically pure foil becomes mirror-like. Reproductions of the standard could be made with chemically pure foil within one per cent.; with the commercial foil, on the other hand, deviations of from two to three per cent.



Zucker & Levett & Loeb Co.'s Patent Corrugated Nickel Anode.

to make uniform the currents of air, and is heated by an electric current from storage batteries. The current required is from 50 to 80 amperes. By the introduction of resistance, the current is adjusted to such an intensity that the radiant efficiency becomes such as desired. In front of the platinum foil is a tube pierced with an aperture one square centimetre in size, and cooled by water circulation. The water cell is made of a cylindrical glass ring, closed by two paralled quartz plates. The quartz plates are each one mm. thick, and the thickness of the layer of water is 2 cm. The bolometer used is that constructed by Lummer and Kurlbaum for such work, and consists of very thin platinum foil, which has been cut away in the form of a grid.

The standard which carries the platinum foil is made to rotate through 90°, so as to face either the bolometer or the photometer. Comparisons of the intensity of the light were made with a glow lamp by means of the Lummer-Brodhun photometer. In determining the constancy of the radiation of the glowing platinum the bolometer was used. Throws of the galvanometer were taken at intervals of one minute, the result showing an admirable occurred. The aperture in the diaphragm could be measured within 0.01 mm., which corresponds to 0.2 per cent. change in light intensity. The cosine law of radiation was found to be followed with such accuracy that no error resulted when the foil was not exactly parallel to the diaphragm. An error of 0.1 mm. in the thickness of the quartz plates of the water cell produced an error in the light intensity of 0.1 per cent., while an error of 0.1 mm. in the thickness of the layer of water produced an error of one per cent.

The greatest difficulty arose from the selective absorption of the material with which the bolometer strips were blackened. It was found to be impossible to get consistent results for the radiant efficiency with various bolometers covered with lamp-black, on account of the lack of uniformity in the thickness of the lamp-black covering on the different bolometers. A good result was obtained, however, by coating the bolometer strips with an electrolytic deposit of platinum black. A solution of definite composition was made, the bolometer strips and platinum strips were immersed in it, and a certain definite current

(Continued on Page 620.)

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CONTENTS.

EDITORIALS
The Coal Supply ... 619
Steam Turbines for Electric Lighting ... 619
GENERAL SUBJECTS
Principles of Static Electricity ... 613
The Daily Inspection and Care of Car Equipments ... 616
Standards of Light ... 617
MISCELLANEOUS
Electric Bridge Cars ... 624
Electric Stock Quotations ... 624
TRADE NOTES
Cylinder Boring in Position ... 615
The Phantoscope ... 616
Zucker & Levett & Loeb Co.'s Patent Corrugated Nickel Anodes. 620
North American Electric Co ... 622
Paragon Iron-Clad Electric Motor ... 622
The McClellan Patent Combination Angle and Breast Drill ... 623
A New Naptha Engine ... 623
Edwards & Co ... 624
The "Ajax" Arc Lamp ... 626
Possible Contracts ... 627
Telephone Notes ... 627
NEW CORPORATIONS ... 627
PATENTS ... 628

THE COAL SUPPLY.

People of a reflective turn of mind have been impressed with the fact that the coal mines of America are likely to be exhausted in the future and may seriously impede commercial progress when such a long-heralded catastrophe occurs. Amongst the transactions of the American Institute of Mining Engineers may be found a paper entitled, "Some Fuel Problems," setting forth figures relative to this condition of things. As stated, more than 70,000,000 tons of coal were produced in 1880, which quantity subsequently increased in 1889 to more than 140,000,000 tons, and in 1893 to 180,000,000. This may be traced to the increase in steam railroads, trolley, gas and electric light plants, iron foundries, manufacturing industries and domestic uses.

A nation's prosperity hangs upon its natural resources, of which the all-important one is fuel. The huge ocean steamers, tug boats and local steamers consume annually a considerable quantity of coal.

From an industrial standpoint the United States has just begun to exert itself. Some great national calamity might possibly put a temporary stop to America's coal consumption; this would slightly affect the present rate, but it could never exercise any influence upon the inevitable increase which the growth of factories and greater extension of engineering enterprises will surely produce, and which the present prospect would lead us to regard with the most serious contemplation.

Our bank account of coal is rapidly diminishing and the mining of it involves a loss of 70 per cent. Nature charges a heavy discount for the power we use both in its potential form and necessary transformation. One hundred pounds of coal in the mine means thirty for transportation, from which one per cent. gives light. The hundred pounds in the earth delivers as light the equivalent of three-tenths and as power three pounds. The loss is enormous and indicates the necessity for the more economical mining of coal and its less wasteful consumption.

A considerable quantity of coal is exported from America and this hurries the commercial inquest that some day must be faced.

The law that governs fisheries, that limits the destruction of seals and imposes restrictions upon the ardent huntsman, may yet stretch its protecting arm over the coal mines of America, to save us from the terrible fate of helpless industrial degeneration.

A national economy must be observed in this respect, or the consequences will be beyond the most delirious dream of the greatest calamity howler.

Mr. Joseph Weeks expresses a calm consideration of the facts when he asks with charming optimism, "is there not in this question a problem that demands most earnest work from our engineers, and in which there is for the miner and manufacturer untold wealth?"

STEAM TURBINES FOR ELECTRIC LIGHTING

In one of the largest electric light stations of this country an experiment is being conducted with a steam turbine direct-connected to a dynamo. The enormous speed of the steam turbine necessarily introduces factors which otherwise would not be so noticeable, that is, vibration as the source of small ills and the mechanical dangers of high speed. At present it is not practical to use so great a velocity in station work, even though its reduction is successfully carried out. The truly serviceable turbine will only compete with the advanced types of modern engines when its rotative speed lies between a few thousand a minute. The added complication of gears, worms or the like, and the destructive tendencies within the turbine are apt to render its introduction a doubtful welcome, at least in station practice.

The Parsons Company of England, and the DeLaval of America, have made strenuous efforts to approach that degree of practical perfection required for station work.

Although the ingenuity exhibited by the manufacturers of turbines deserves the highest praise, we can predict a stay to their popular use for at least five years to come. By that time the speed will have become reduced without external assistance, and in all probability the dynamo, having undergone certain modifications of a charactor required for such work, will add to the ideal perfection of the plant.

ELECTRIC BRIDGE CARS.

The Brooklyn bridge termini will be equipped with motor cars for the purpose of saving the short interval required for switching at either end.

The locomotive can be dispensed with, and the time of coupling saved. During the "rush" hours greater headway can be made with the crowd and much vituperation dispensed with. The cars are forty-five feet long, weigh twenty-eight tons, or a total of thirty-six tons with the four 100-H. P. motors.

They will be used at night as well, when the cable is shut down, the current being taken from a rail conductor by a shoe contact.

Quebec, Que.—The adjourned meeting of the Quebec Street Railway Construction Company will be held on Thursday, when the provisional directors will be elected. It has been decided to close the subscription books. The main lines from Lower Town to St. Roch's will be commenced immediately, and it is expected this part of the line will be completed this autumn.

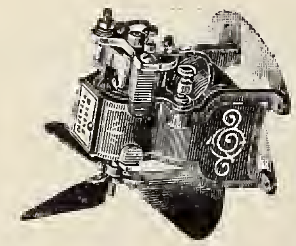
(Continued from Page 618.)

was passed through for a definite time.[5] This resulted in a coating which was absolutely uniform, and has enabled consistent results to be obtained for the radiant efficiency. The conclusion reached as the result of these experiments is, that by using such apparatus and by taking careful account of all the possible sources of error, a light unit is obtained which can be reproduced within one per cent.

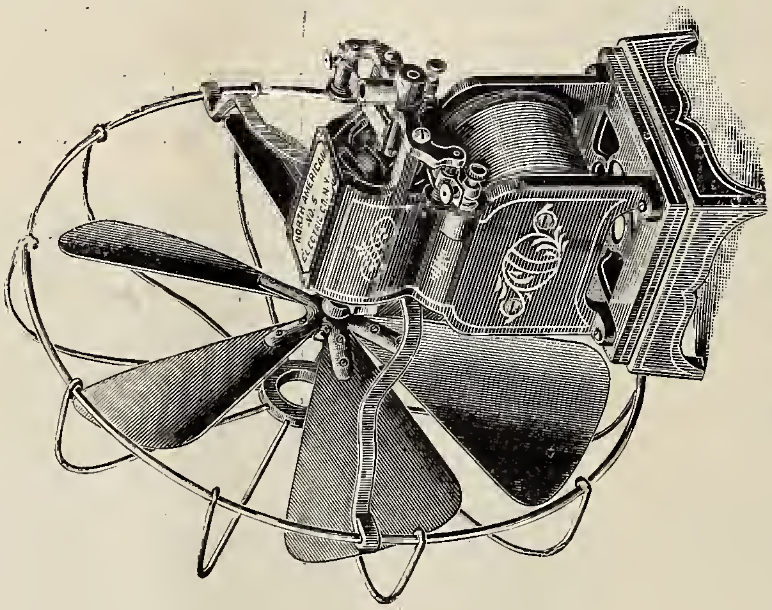
ZUCKER & LEVETT & LOEB CO.'S PATENT CORRUGATED NICKEL ANODES.

Patented July 28, 1896.

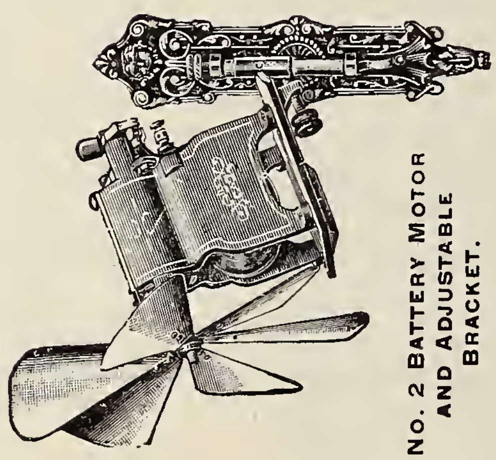
In nickel-plating by the action of the electric current the following takes place during electrolysis: both the sulphate of nickel and the sulphate of ammonia undergo decomposition; sulphuric acid and ammonia are set free at the anode; this sulphuric acid forms an equivalent quantity of sulphate of nickel by its action on the anode, which it dissolves; free ammonia is liberated, some of which is left to accumulate; this will make the solution decidely alkaline in time; the more intense the electric current the more rapid the decomposition; hence the more ammonia is liberated the more alkaline the solution becomes, and if the current is too intense the solution will become too alkaline, which will more or less influence the quality of the work. Accompanying this change in the solution, especially with an irregular or too intense current, there is a precipitation of the nickel in the form of basic salt, by which the metallic strength of the bath is impaired. This necessitates the addition of fresh nickel salts from time to time. Hydrogen and nickel are given up at the cathode, the nickel is deposited on the work pure, and the hydrogen liberated, hence the more intense the electric current the more hydrogen is eliminated, which makes the deposit brittle and strip, especially if the nickel is deposited thick. This is owing to the hydrogen at the cathode being occluded by the electro-deposited metal.



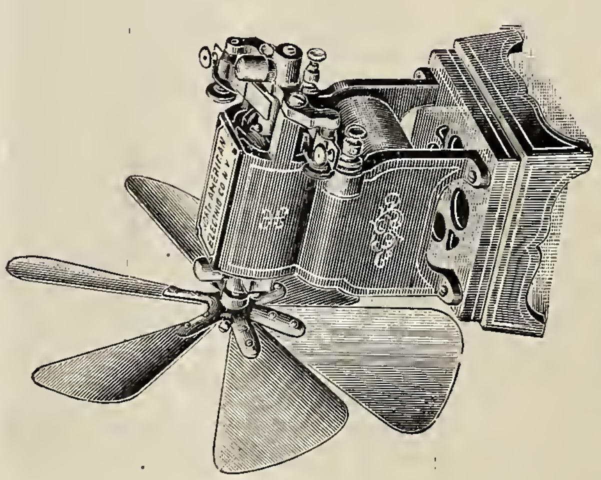
No. 1 Battery Motor.



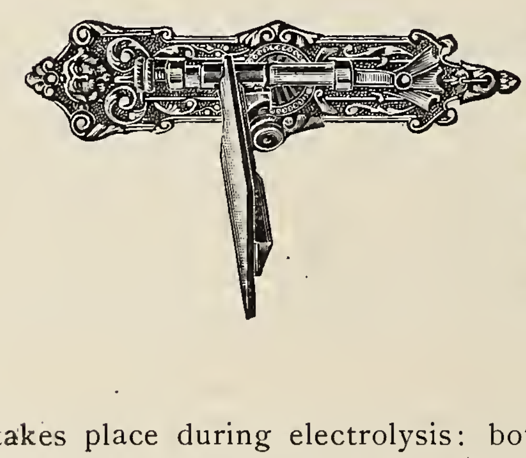
No. 4 Battery Motor.



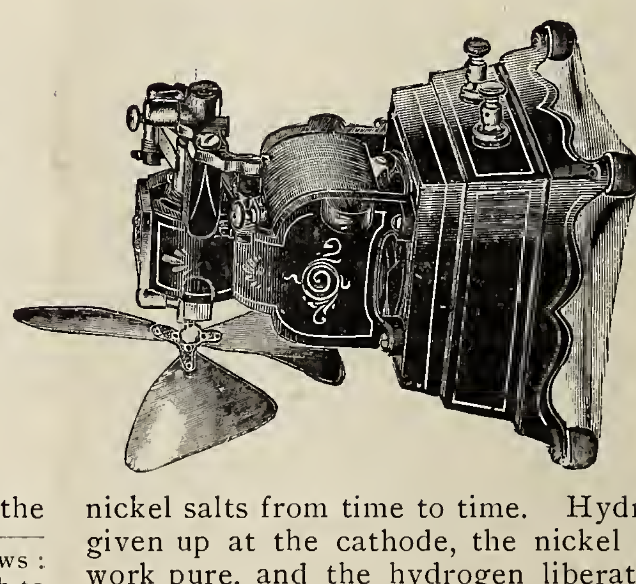
No. 2 Battery Motor and Adjustable Bracket.



No. 3 Battery Motor.



No. 1 Adjustable Bracket.



No. 1 Incandescent Motor.

North American Electric Co.'s Motors and Bracket.

5. For a bolometer of 8 cm.^{2} area, the solution is as follows: Platinum chloride, 1 part; water, 30 parts; lead acetate enough to make one part to 4,000 parts of water. The temperature of the solution should be 20°; the E.M.F. 4 volts; the current 0.25 ampere. The current is allowed to pass for two minutes. The bolometer strip is placed between two platinum electrodes so that both sides are equally blackened. See *Zeitschrift fur Instrumentenkunde*, Aug., 1895.

In order to obviate the above difficulties a current of low voltage and large amperage must be employed, but by employing such low voltage there is not sufficient nickel dissolved from the anodes by the action of the sulphuric acid which is given off at the anodes, and there is not enough nickel deposited on the work. Consequently, it has always been necessary, up to the present time, to employ an electric current of from four to six volts in nickel-plating.

It has been determined if an electric current of from $1\frac{3}{10}$ to $1\frac{1}{2}$ volts could be employed, there would only be sufficient ammonia given off at the anode to keep the bath neutral, and there would only be a small amount of hydrogen given off at the cathode, not enough to be occluded by the deposited nickel.

These two defects would be obviated, but there would not be sufficient nickel dissolved by the action of the sulphuric acid upon the nickel anodes, and as there would not be enough sulphuric acid given off to dissolve the nickel and supply the bath with the same amount of nickel which is deposited on the work, the bath in time would lose a large amount of nickel, which would have to be supplied by the addition of fresh nickel salts (double sulphate of nickel and ammonia).

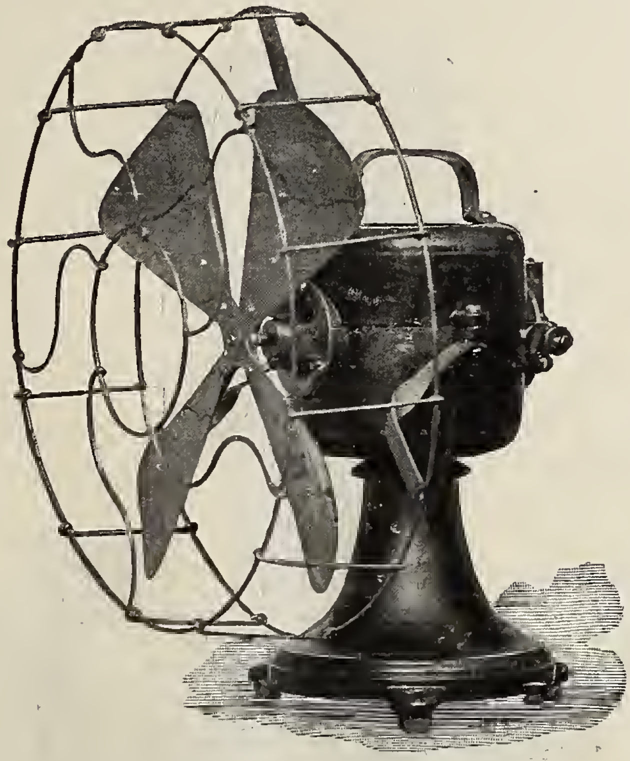
Another reason for a large anode surface is that nickel solutions are feebler conductors of electricity than either gold, silver or copper. On this account it is necessary to employ stronger depositing solutions, a large anode surface, to make up for the want of conductivity.

By using the plain flat anodes, even when the tank has been filled to its fullest capacity with them, it has been found that it was impossible to expose a sufficient surface of nickel to this action.

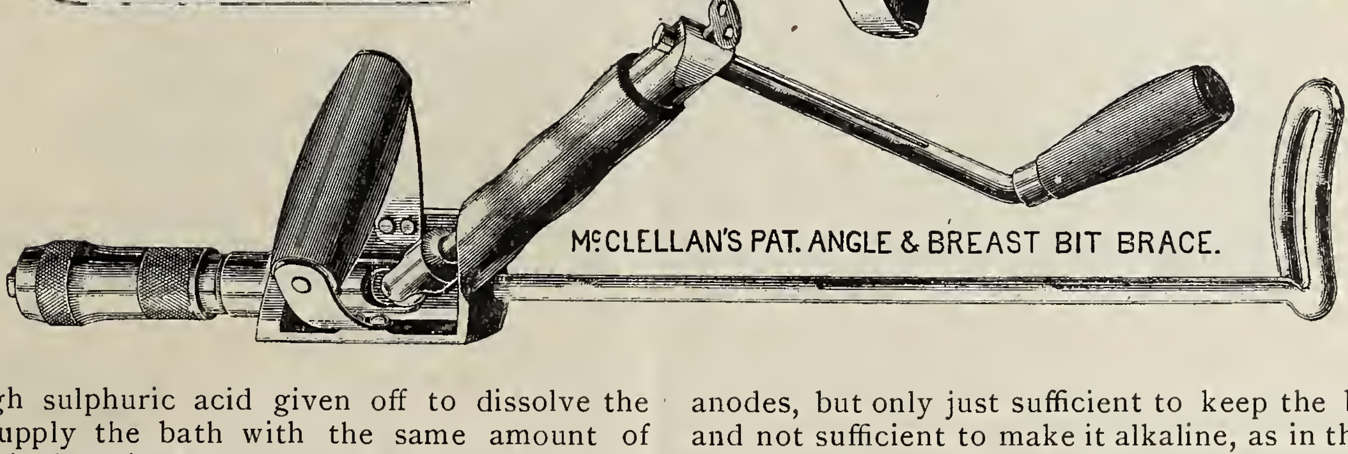
By means of the patent corrugated nickel anodes these defects have been overcome for the following reasons: nickel being so insoluble, there must be a large quantity of same exposed to the action of the sulphuric acid which is given off, in order to supply the bath with the proper amount of metal to keep up the strength.

It has been found by practical tests, by employing the patent corrugated nickel anodes the surface of nickel in the bath is just sufficient to supply it with the same amount of nickel which is deposited on the work by employing a current of $1\frac{3}{10}$ to $1\frac{1}{2}$ volts. This being the case there is not too much ammonia given off at the anodes, but only just sufficient to keep the bath neutral, and not sufficient to make it alkaline, as in the case if four to six volts are used. Also the amount of hydrogen given off at the cathode is so little that it would not be occluded by the deposited nickel; consequently the deposit of nickle obtained is malleable, white, coherent, adherent, tenacious and free from porosity.

The gases given off at the anode in the case of the ordinary flat anodes shoot straight across to the cathode



Paragon Iron-Clad Electric Motor.



McCLELLAN'S PAT. ANGLE & BREAST BIT BRACE.

and materially injure the quality of the nickel deposited. In the case of the patent corrugated nickel anodes the gases shoot diagonally from the corrugations, striking each other about 1½ to 2" from the anodes and come up to the surface without striking the deposit of nickel or the cathode.

To get the proper working of nickel plating has always been a difficult problem, and we are pleased to note that the same has at last been solved. These anodes are made by the Zucker & Levett & Loeb Co., No. 526 W. 25th Street, N. Y.

NORTH AMERICAN ELECTRIC CO.

The North American Electric Co., in placing their motors before the public, desire to make known the following facts:

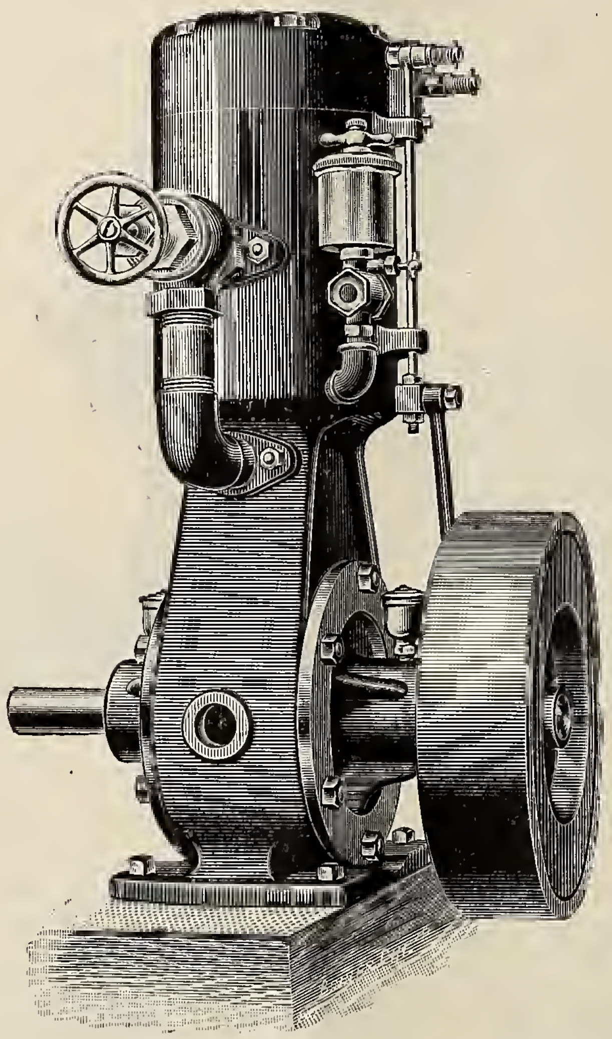
Their motors are made of the best materials, handled by experienced workmen and finished to an extent rarely seen in any other motors. For their size and power they are very cheap, and therefore leave no excuse with the purchaser to give them other than a fair trial. In the details of brush holder and commutator, there is nothing to be desired for greater convenience and good construction. The oiling arrangement is clean and serviceable. The brushes may be easily slipped off, turned over if worn, or replaced without the least difficulty.

The sizes run from No. 1 up, including motors for either battery or incandescent circuits. One of their types is mounted on a bracket that cannot only be moved sideways, but raised or lowered at will by screw. For desk fans, jewellers' or dental work, sewing machines or heavy ventilation, the North American motors are particularly adapted. Office and salesroom, 181 William street, New York.

The Electric Arc Light Company. Nos. 687 and 689 Broadway, New York, are doing a rushing business in their "enclosed arc lamps." The popularity of the present lamp makes the trade hustle to supply it.

PARAGON IRON-CLAD ELECTRIC MOTOR.

I beg to inform the public that after having the benefit of several years' experience in building the Globe fan motor and placing it on the market, and taking advantage of that experience, I have succeeded in perfecting a direct-current fan motor that complies with all the requirements of the trade and combines the qualities of cheapness, durability, appearance and efficiency, and is a thoroughly up-to-date article.


A New Naptha Engine.

The name of the new motor is the Paragon. It does not heat and runs at full speed of 2,000 revolutions per minute, and 1,500 revolutions at half speed. It is built in the best manner possible, has a twelve-section armature, lock-nut commutator, is mica insulated and built just as carefully as a large dynamo. It is a very powerful machine and bound to be a good seller, being handsome in design and full of up-to-date improvements.

My catalogue of the new motor will be ready for mailing between now and November 1, when I shall be pleased to mail you a copy of the same. I shall be pleased to call on you with a view of placing agency between November 15 and December 15, and will have sample motor to show, of which you can make tests. Those of the trade who have seen the Paragon motor assert that the same is superior to any fan motor on the market.

The price will be below anything now sold. These machines will be warranted in every respect, and I feel confident will meet the most exacting demands of the trade and consumer at a moderate cost. I will have the Paragon motor in three sizes, viz., 12-inch, 14-inch and 16-inch, both in plain dipped, polished and black japanned. The motor is enamelled in dark green and striped with gold leaf; it will also have the Paragon ceiling fan, with either metal or wood sweeps.

Await my catalogue and prices before placing contracts for other fan motors.

J. P. WILLIAMS,
Nos. 39-41 Cortlandt Street, New York.

North Bay, Ont.—The question of lighting the town by electricity is under consideration.

THE McCLELLAN PATENT COMBINATION ANGLE AND BREAST BRACE.

This brace is especially adapted to work where it would be impossible to bore a hole with any other tool. It is the latest improved tool of its kind, and for car wiring and builders will be greatly appreciated. Holes can be bored in closer space, eight inches, than with any other brace; holes bored are absolutely in line with point of rest of the angle. No wobbling about of brace when in use; can also be used as a breast brace; readily taken apart and put together. Finest workmanship; sweep of handle ranges from two inches to thirteen inches.

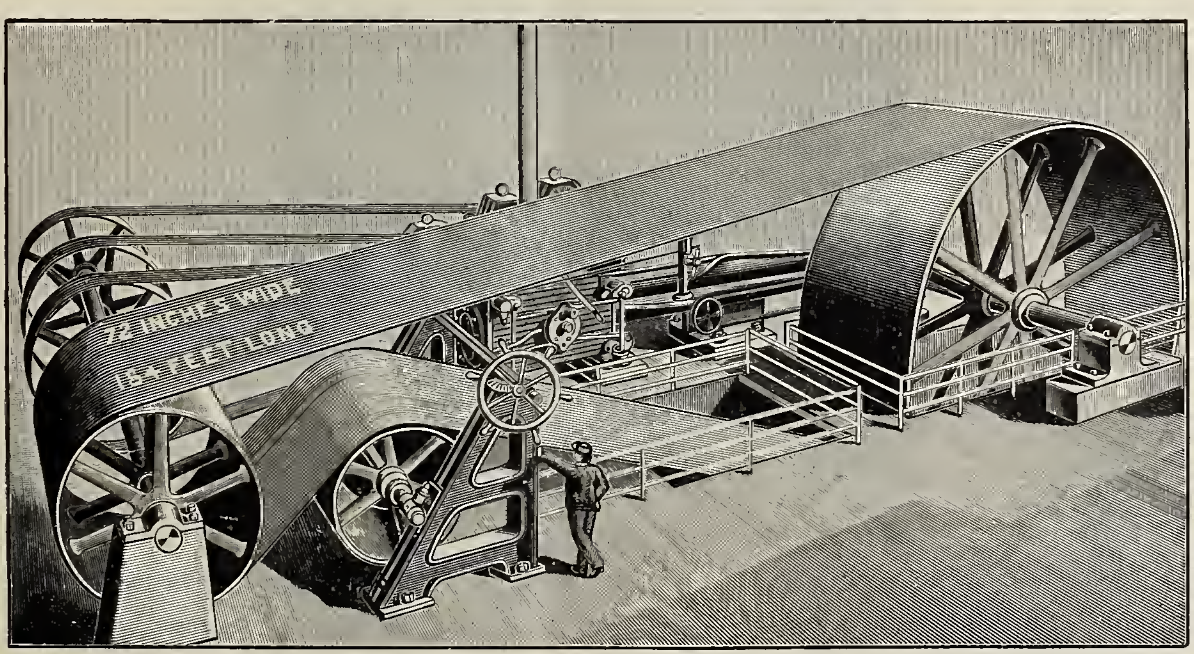
Elmer P. Morris, selling agent, 36 Dey street, New York.

The genuine Shultz belting can be detected from the imitation by the fact that every ten feet is stamped *Sable*.

The electrical trade have to thank the Shultz Belting Co. for the high grade quality of their belts and the excellent service they give. Some of the best firms in the

J. A. J. Shultz.

country use the Shultz belt. Such customers as Thos. A. Edison, Edison Phonograph Co., Edison General Electric Co., Westinghouse, Church, Kerr & Co., etc., etc., and many electric light and power stations use the Shultz belt exclusively. Their link belt, as seen in sketch, embraces the pulley and fly-wheel to a considerable extent,



Shultz Belt in St. Louis and Suburban R. R. Co.'s Plant.

reducing the slip to a minimum. The power station of the St. Louis and Suburban Railroad Co. was belted with three 72-inch belts, each 154 feet long; two 34-inch and ten 16-inch generator belts of the Shultz patent sable rawhide make. The extensive works of the Shultz Belting Co., in St. Louis, Mo., are seen in sketch.

Messrs. J. A. J. Shultz and A. B. Laurence, the founder of the company and the New York manager, have a host of friends in the trade. Mr. Shultz is noted for his uniform courtesy and good will; and Mr. Laurence, as manager, in every case meets the expectations of the worthy firm to which he belongs.

He reports a very excellent business among the largest manufacturers of the United States. The export orders have been piling in, including a very heavy demand from Africa. A large business is being done in the Shultz patent leather pulley coverings.

A NEW NAPTHA ENGINE.

This engine, for the first time offered, presents some entirely new features in a boat engine, which render it especially desirable as a motive power for small boats and launches.

Heretofore, we believe, all naptha launches have required the presence of a flame burning in the generator while it was in operation, to vaporize the naptha, and also required the presence of several gallons of naptha in the boat at all times. By the entirely different system upon which this engine operates, there is no fire in the boat whatever.

A. B. Laurence.

An electric spark from a sealed battery ignites the gas inside a closed iron cylinder and furnishes the motive power. Only a small quantity of naptha need ever be carried in the boat at one time, and this may be of the very lowest specific gravity, consequently the safest and least inflammable grade manufactured.

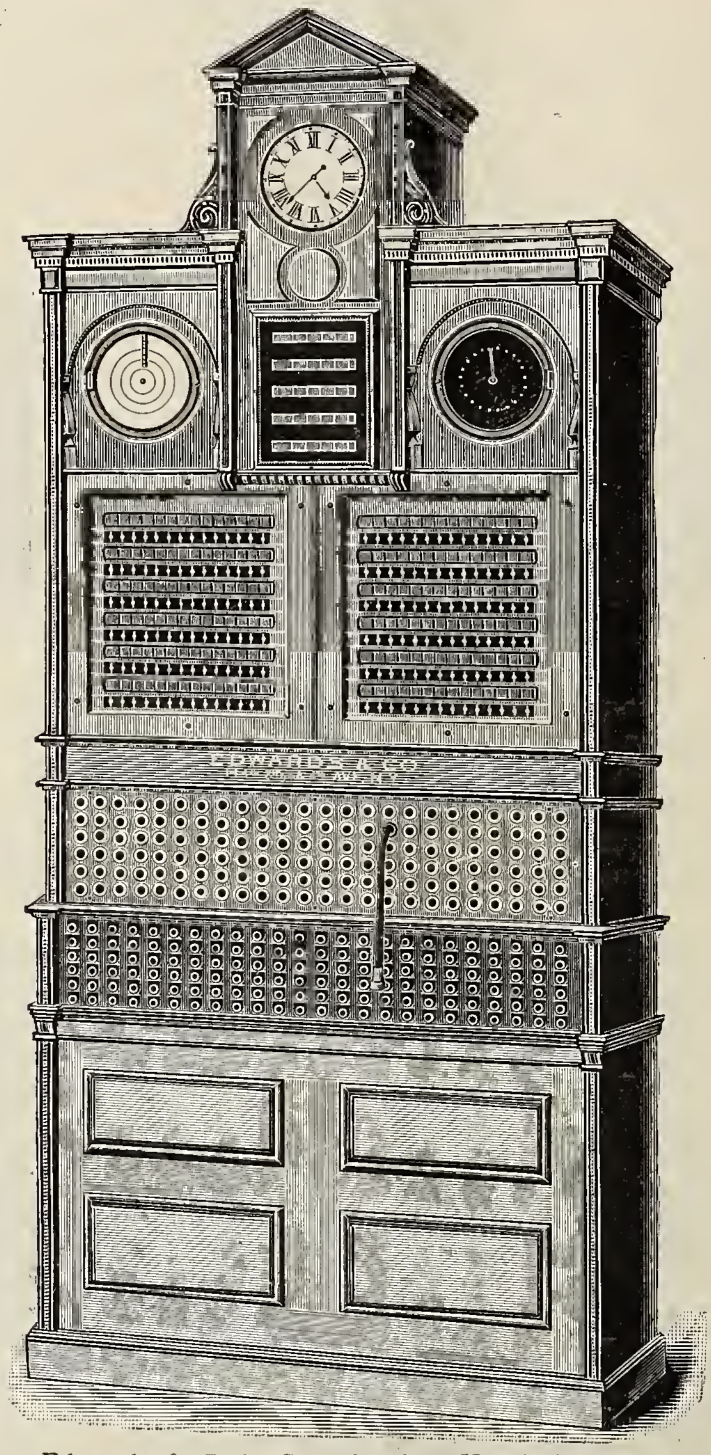
These engines are sold complete ready to put into the boat, or boats complete and ready for operation will be furnished by the manufacturers. Full particulars with prices may be obtained by addressing Chas. P. Willard & Co., 197 S. Canal street, Chicago.

Gadsden, Ala.—The construction of a telephone line has been commenced by R. L. Adams. The line is to run to Alabama City, Attalia and Walnut Grove.

EDWARDS & CO.

Edwards & Co., of 144th street and Fourth avenue, are meeting with great success in the sale of their combination hotel apparatus.

It is for use in first class hotels, being very complete and extremely convenient. It consists of a return call annunciator, burglar alarm, with a switch for each section; terminal board for speaking tubes, with flexible mouthpiece; watchman's time detector; fire-alarm; fine self-winding or fifteen-day pendulum movement, and a highly finished cabinet case, artistically designed. In connection with the fire-alarm they use their No. 77 fire-alarm box. A drop in the annunciator is provided for each station or box. In case of an alarm, made by breaking the glass of the fire-alarm box, the location of the fire is indicated by the annunciator and all fire bells kept ringing until the switch is turned off. The excellence of Edwards & Co's. specialties have enabled them to command some of the best trade. They are very busy with fall orders, the factory running full swing.



Edwards & Co.'s Combination Hotel Apparatus.

Poor's Manual this year presents features of great detail and labor in the statements of the principal companies. These statements, it is believed, will prove of unusual public interest. It is of great value to those interested to have the affairs of all companies set out in one volume. The labor and expense involved in the publication of a report of a single company will well illustrate what is involved in the publication of the Manual, containing statements of more than 4,000 companies. Yet, notwithstanding the great increase in the cost of compiling and printing the book, its price remains at $7.50 per copy—no greater than that charged for certain city directories. Address 44 Broad street, New York.

ELECTRIC STOCK QUOTATIONS.

Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
*Edison Elec. Illg. Co., New York,	91	95
*Edison Elec. Illg. Co., Brooklyn,	93	95
Edison Ore Milling Co.,	7¾	10
Edison Elec. Storage Company,	27⅞	28½
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co., T. Sec. Series A,	2½	4
General Electric Company,	27	28
General Electric Company, pf.,	58	61
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	147	—
Narragansett (Prov., R. I.) Elec. Co.,	79	81
Rhode Island Elec. Protec. Co.,	—	122
Royal Elec. Co. (Canada),	105	115

Toronto (Canada) Elec. Light Co.,	—	132
T. H. Elec. Co., T. Secur., Series D.,	3¼	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	95	105
Westinghouse Elec. & Mfg. Co.,	23	24
Westinghouse El. & Mfg. Co. pf.,	48½	50
Westinghouse El. & Mfg. Co., assd.,	—	—

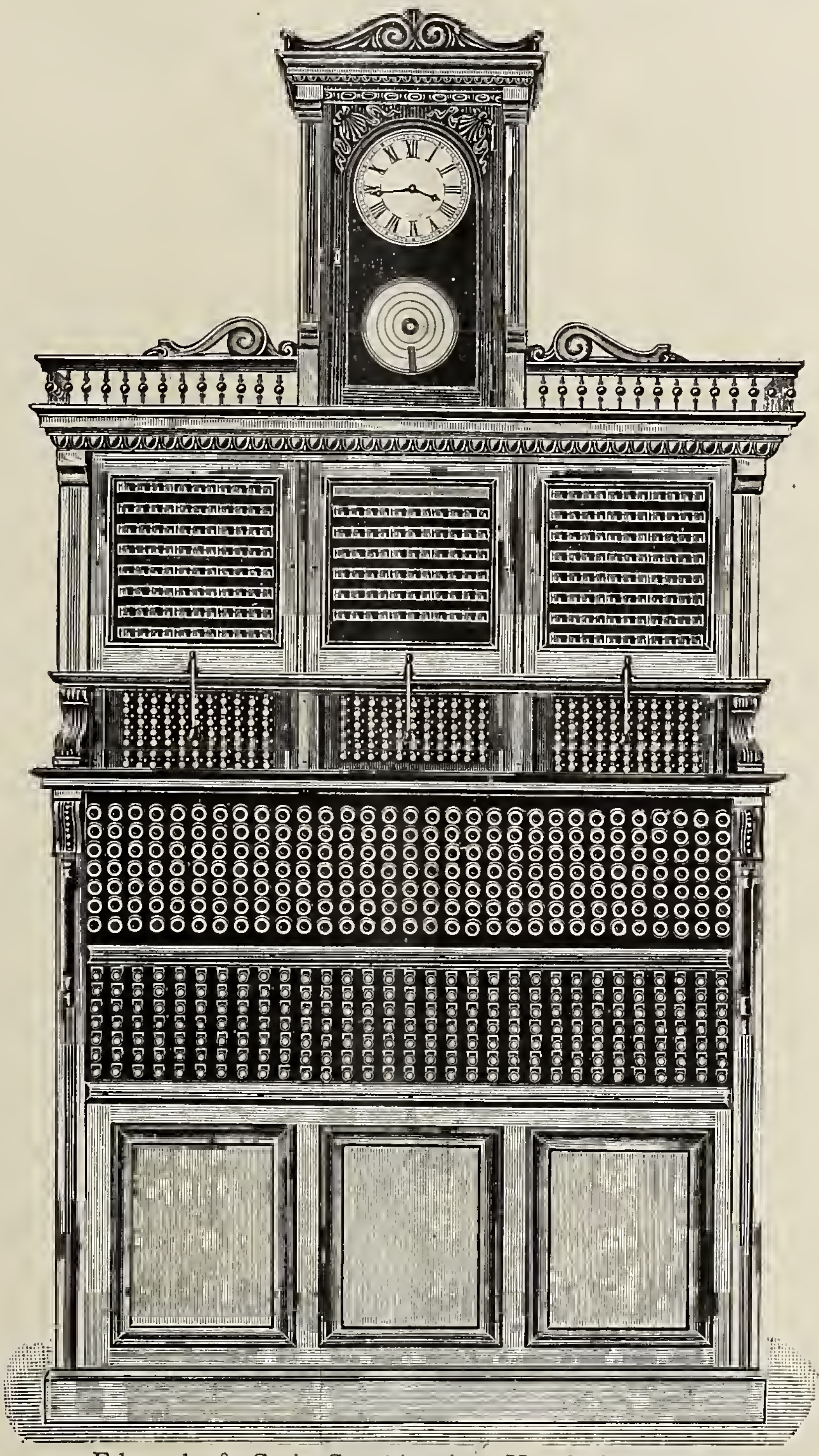
*Ex dividend.

Death by Shock.—When a powerful current suddenly enters the body the shock is enormous. The vital processes are stopped. A great molecular change ensues. It is likely that the patient will become delirious if recovery is possible, and possibly paralysis or other organic disease will develop. The blow to the nerve centre is destructive in the extreme. A change in the blood destroys the vital qualities and the extent of the physical injury may be general and permanent.

ent hydraulic canal was dug and the mills were set up, which, like hucksters' booths around an old Italian Cathedral, disfigure the banks just below the stately Falls, their discharge of the water uneconomically used at low pressure being the only picturesque element in the scene.—F. Comerford Martin.

Efficiency of Plain and Ribbed Glass.—Experiments to test the relative efficiencies of plain and ribbed glass have shown most conclusively that much more light is thrown into the darker corners of rooms when ribbed glass is used. It would appear that the corrugations act to some extent as magnifiers or prisms, and the rays of light are transmitted with greater illuminating power and more general diffusion than in the case of plain glass.

Bristol, Va.—An application for a franchise has been made by C. C. Cochran for the erection and operation of an electric light and power plant.



Edwards & Co.'s Combination Hotel Apparatus.

Niagara on Tap.—The broad idea of the utilization of Niagara is by no means new; for even as early as 1725, while the thick woods of pine and oak were still haunted by the stealthy redskin, a miniature saw-mill was set up amid the roaring waters, that long remained far more familiar with the savage warcry of Iroquois or Senecas than the creak and splash of our ancestors' primitive machinery. The first systematic effort to harness Niagara was not made until nearly 150 years later, when the pres-

According to the Industrial Journal of Bangor, Me., patents have been allowed on electric controllers for elevators to the Belknap Motor Company of Portland and also on voltage controllers for varying speed dynamos. Both are wonderful inventions that are sure to make this company wealthy. The elevator controller is the simplest and most effective on the market and enables this company to handle the electric elevator business in competition with the world.

THE "AJAX" ARC LAMP.

A new enclosed arc lamp that has already given a very good account of itself is the "Ajax," manufactured by Pomeroy, Woltmann & Co., 43 Cortlandt St., New York, and which, it is claimed, will find favor with users of long life lamps. Among the special features commending the Ajax lamp is the arc-enclosing globe, which rests upon an air-tight, ground joint base, and for its cap has a series of three chambers, each successive one a little smaller and further removed from the arc, thereby greatly impeding the entrance of oxygen into the inner globe, and causing a very steady light and but little combustion at the carbon points.

The outer globe-holder is also a very simple and neat device, allowing the globe to swing entirely free from the lamp frame, and on this account and because the arc-enclosing globe rests upon a ground joint base, it is probably the easiest lamp on the market to trim.

Then, too, the shape of the inner globe is such that, while the neck is large enough to admit of easy cleaning, the conformation is such as to insure an even distribution of the rays of light.

For large interiors the light from Ajax enclosed arcs is second to none, it being a beautiful, soft, white light of unequalled steadiness.

"Ajax" Enclosed Arc Lamp.

"Ajax" Enclosed Arc Lamp.

The lamp consumes 4.7 amperes of current and carries an 80-volt arc.

A rack rod with a simple and positive escapement is used in preference to the clutch mode of feeding, and all steel parts of the movement are nickel plated to prevent rusting.

Bucyrus, O.—The commissioners of Crawford County yesterday granted William Haycox, of Mansfield, and Fred. Perkins, of Toledo, a franchise or right of way between this city and Galion for an electric railway. The road is to be in operation before December of next year.

Birmingham, Ala.—The new cotton factory at Prattville will be heated by steam and lighted by electricity.

POSSIBLE CONTRACTS.

Pittsburgh, Pa.—McCune & Bros. will erect a fire-proof seven-story warehouse at 336, 338 and 340 Second avenue, at a cost of $100,000.

Flushing, L. I.—The trustees of the village of Flushing, L. I., have decided to install 40 arc electric lights. For this purpose bonds in the sum of $4,000 will be issued and sold as soon as possible.

Boston, Mass.—Sealed proposals for the general work, for the steel construction for the dome, for heating and ventilation and for electric wiring, addressed to the State House Construction Commissioners, and indorsed "Proposals for Restoring and Preserving the Bulfinch State House," will be received at their office, No. 27 Mt. Vernon street, Boston, until twelve o'clock, noon, October 30th, 1896, at which time they will there be publicly opened and read. Each bid must be signed by the bidder and accompanied by a bank cashier's check for five hundred dollars, payable to the State of Massachusetts. Plans and specifications may be seen at the office of Arthur G. Everett, architect, in the Bulfinch State House, Boston, Mass.

Office of the Lighthouse Engineer, Second District, Boston, Mass., October 9, 1896.—Sealed proposals will be received at this office until twelve o'clock noon of the ninth of November, 1896, for furnishing the materials, appliances and labor of all kinds necessary for the construction, erection, completion and delivery of the Butler Flats light tower, New Bedford Harbor, Mass.

Proposals for electric lighting plant, Watertown Arsenal, Mass., October 12, 1896.—Sealed proposals for furnishing and installing an electric lighting plant at this arsenal will be received until 12 m., October 26, 1896. Information furnished on application to J. W. Reilly, Major Ord. Dept., Comd'g.

Elizabeth, N. J.—Efforts are being made by the property owners to introduce electric lights on Springfield avenue, between the West Summit depot and the Methodist church.

Utica, New York.—Ground has been broken for the new power house at Mohawk by Jones & Shippey, of this city.

Lowell, Mass.—The American Tool and Machine Company is to erect a five-story building corner of Beach and Utica streets, Boston.

Philadelphia, Pa.—Harry Peale, architect, Harrison building, has finished plans for additions to the Hotel De Ville for Mrs. Truitt. This addition will be six stories high with a basement, and will have all the following conveniences and modern improvements: Steam heating, electrical work, including combination gas fixtures, wiring, bells, annunciators, etc.; speaking tubes. The cost of this addition will be about $30,000, including all sub-contracts.

Architect B. F. Livezy, 625 Walnut street, is taking bids on an alteration to a residence located at Pennington, N. J. The following latest improvements and conveniences are to be included in the general contract: Hot water heating, electrical work and sanitary plumbing and drainage.

The Standard Sugar Refinery Co. will erect a plant at Kaighn's Point, Camden.

Architect Thomas Bennett is drawing plans for one hundred houses to be built at Twenty-eighth and Huntington streets. The following latest improvements will be put in: Hot-air heating, electrical work, including combination gas fixtures, wiring bells, annunciators, speaking tubes, etc. The cost of the operation will be about $260,000, including all sub-contracts.

NEW CORPORATIONS.

Beaver Falls, Pa.—An application has been made for a charter for the Valley Electric Heat and Power Company. The incorporators are H. W. Reeves, W. A. McCord, L. M. Eckert, S. B. Reeves and others. The surplus from the electric plant now being erected here for the McCord Tube Company will be used.

Albany, N. Y.—Puritan Electric Company of New York City, has been incorporated to manufacture arc lamps, electrical and mechanical apparatus. Capital, $100,000. Directors, James R. Burnett, of 207 Broadway, New York, and Frederick P. Delafield, Benjamin A. Gould, Jr., Carl L. Schurz and Cortlandt Betts, of New York City.

The Akron Light, Fuel and Power Company, of Akron, Erie County, has been incorporated. Capital, $10,000. Directors, J. W. Stearns, J. Henry Troutman, Irving D. Eckerson, Richard H. Bell, of Akron, and John S. Campbell, of Butler, Pa.

Salt Lake City, Utah.—The Electrical Supply Co. has been incorporated with a capital stock of $20,000. R. W. Nicol, president; E. Mill, vice-president, and S. J. Weigel, secretary.

TELEPHONE NOTES.

Columbia, Pa.—The work of constructing the line of the Columbia Telephone Company will commence in a few days. The Company's exchange will be located in the Cleaver Building, No. 219 Locust street.

New York City.—The Drawbaugh Telephone and Telegraph Company has applied to the board of Electrical Control, of this city, for a franchise to establish a telephone system.

Pittsburgh, Pa.—The new Braddock telephone company is now in satisfactory operation in the Masonic Building.

Amherst, Mass.—The Northfield Telephone Company is going to introduce the Swedish telephone system in this city. The wires will be strung in a few days, and if the system succeeds it will be rapidly increased and introduced in the adjoining towns.

Delhi, N. Y.—The telephone exchange will soon be completed and ready for business.

Hattiesburg, Miss.—The contract will be let for the construction of a telephone line from Hattiesburg to Meridian, a distance of about one hundred miles.

Dresden, N. C.—Telephone lines will be constructed from several cities in North Carolina to different points in Virginia. Address the President, Dr. J. O. Wilcox.

Norfolk, Va.—Application to the city council has been made by the American Telephone and Telegraph Co. for permission to erect long distance telephone and telegraph lines in this city.

The Portland Star Match Company will light their factory by electricity. The Belknap Motor Company will furnish the power.

Fleming & Poillon, selling agents, 39 and 41 Cortlandt street, N. Y., report a flourishing business in trolley insulation, switchboards and switches. They have sold many motors and dynamos for the Commercial Electric Co. The two firms which they represent, the Fiberite Co. and the Commercial Electric Co., have been well supplied with orders. As electrical engineers they do excellent work and exceed, if anything, the good recommendations which follow them.

J. H. Bunnell & Co.'s classified catalogue of electrical books has been well revised and represents a collection of valuable books of popular and technical importance. Their address is No. 76 Cortland street, N. Y.

The Edison Electric Illuminating Company reports gross earnings for September $163,993, an increase of $15,688, as compared with the same month of last year, and net $71,592, an increase of $8,505. For the nine months ending September 30, the gross earnings were $1,581,806, an increase of $147,585 as compared with the corresponding period of last year, and net $747,755, an increase of $86,410.—N. Y. Journal.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued September 8, 1896.

567,132. Telephone Transmitter. R. P. Green, Columbus, Ohio. Filed May 31, 1895.

567,133. Trolley Wire Crossing. R. M. Handshy, San Antonio, Tex. Filed March 19, 1896.

567,137. Automatic Circuit-Breaker. E. M. Hewlett, Schenectady, N. Y. Filed April 17, 1896.

567,156. Electric Lock. W. S. Nash, Knoxville, Tenn. Filed November 21, 1895.

567,170. Telephone Switch. D. Rousseau, New York, N. Y. Filed March 18, 1895.

567,176. Contact Device for Electric Burglar Alarms. P. Unger, Lemont, Ill. Filed June 22, 1896.

567,186. Trolley Wire and Trolley Wheel. P. Cassidy, Worcester, Mass. Filed May 8, 1896.

567,197. Constant-Potential Alternating Generator. E. W. Rice, Jr., Schenectady, N. Y. Filed May 15, 1896.

567,211. Electrical Train-Signaling Device. J. E. Young and E. S. Norton, Conneaut, O. Filed May 11, 1896.

567,223. Rheostat. W. W. Dean, St. Louis, Mo. Filed March 28, 1896.

567,227. Electric Arc Lamp. E. F. G. H. Faure, and J. MacHaffie, Schenectady, N. Y. Filed March 20, 1896.

567,237. Electrical Transformer. H. M. Hobart, Boston, Mass. Filed May 15, 1896.

567,247. Electric Heater. J. E. Meek, New York, N. Y. Filed January 7, 1896.

567,248. Electric Heater. J. E. Meek, New York, N. Y. Filed January 7, 1896.

567,250. Electrical Transformer. W. S. Moody, Lynn, Mass. Filed March 30, 1896.

567,257. Electric Rail-Bond. G. H. Scott, Worcester, Mass. Filed March 9, 1896.

567,306. Electric Railway Trolley. R. N. Dyer, East Orange, N. J. Filed April 30, 1896.

567,307. Electric Railway Trolley. R. N. Dyer, East Orange, N. J. Filed April 30, 1896.

567,322. Safety Device for Hanging Electric Arc Lamps. E. P. Snowden, St. Joseph, Mo. Filed January 23, 1896.

567,324. Telephone Transmitter. A. Stromberg and A. Carlson, Chicago, Ill. Filed October 29, 1895.

567,325. Telautograph. G. S. Tiffany, Highland Park, Ill. Filed June 7, 1895.

567,338. Electric Signal Lamp. J. R. Farmer, St. Louis, Mo. Filed March 14, 1895.

567,355. Arc Lamp Clutch. H. R. Palmer, Norfolk, Va. Filed June 10, 1896.

567,366. Governor for Regulating Speed of Machinery. E. Thunderbolt, Carlton, Victoria. Filed July 10, 1896.

567,381. Magnetic Separator. R. Eickemeyer, Yonkers, N. Y. Filed January 10, 1890.

567,382. Magnetic Separator. R. Eickemeyer, Yonkers, N. Y. Filed January 28, 1890.

567,404. Apparatus for Telephone Switchboards. F. R. McBerty, Downer's Grove, Ill. Filed January 24, 1896.

567,411. Trolley. E. D. Priest, Schenectady, N. Y. Filed May 13, 1896.

567,416. Insulated Rail Joint. R. C. Scofield, Boonton and J. Wayland, Newark, N. J. Filed July 22, 1896.

567,422. Galvanic Ring. M. L. Thompson, Brooklyn, N. Y. Filed June 29, 1896.

567,423. Dynamo-electric Machine. R. Thury, Geneva, Switzerland. Filed August 5, 1895.

567,424. Transformer for Electric Currents. R. Thury, Geneva, Switzerland. Filed February 3, 1896.

567,474. Trolley for Electric Cars. J. E. Hewes, Philadelphia, Pa. Filed May 7, 1896.

567,487. Car Storage Arrangement. E. F. Mann, Detroit, Mich. Filed November 20, 1895.

567,514. Advertising Device. F. A. Ruge, Springfield, N. Y. Filed May 22, 1896.

567,517. Electric Railway. C. Sill, New York, N. Y. Filed November 1, 1895.

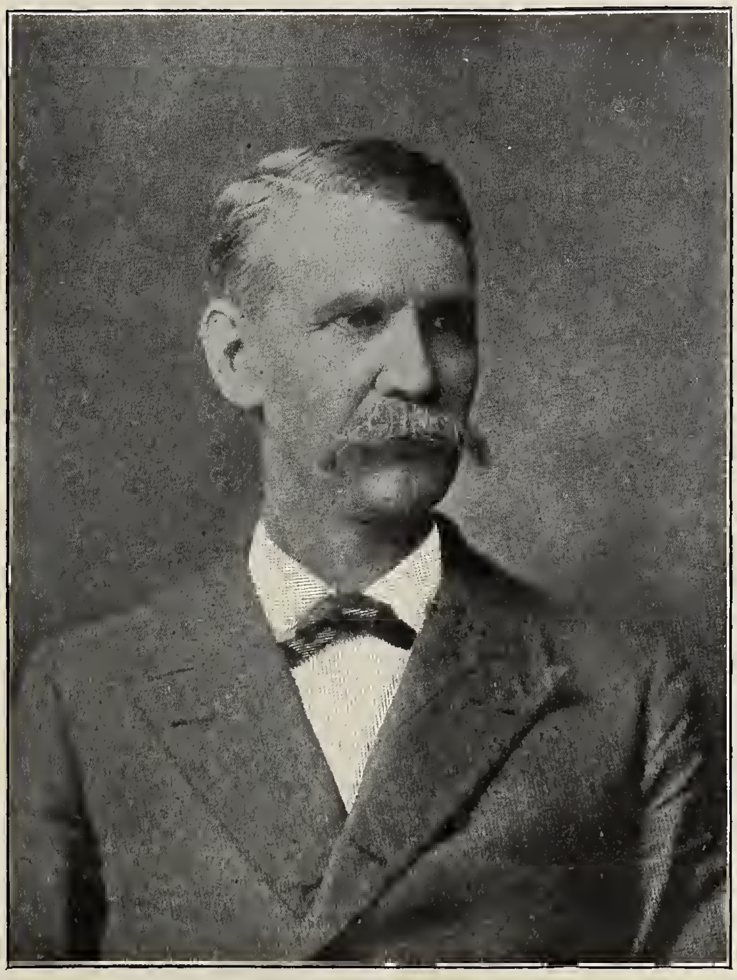
567,531. Holder for Electric Lamps. W. S. Arnold, San Francisco, Cal. Filed March 17, 1896.

567,540. Electric Railway. W. F. Grassley, Williamsport, Pa. Filed May 8, 1896.

567,550. Swing for Electric Light or Telephone Brackets. A. Petereit, New York, N. Y. Filed November 15, 1895.

The Electrical Age.

Vol. XVIII., No. 18. NEW YORK, OCTOBER 31, 1896. Whole No. 494



President Robert McCulloch.

THE AMERICAN STREET RAILWAY CONVENTION.

President-Elect McCulloch.

Captain McCulloch is of Scotch lineage, his ancestors having settled in Virginia in the Colonial days, the paternal side in Amherst County and the maternal in Roanoke, the male members on both sides having been soldiers of the Revolution. He is a native of Rockbridge County, Virginia, and was educated at the Virginia Military Institute, at Lexington, Virginia. He went as a cadet in the Confederate service in April, 1861, and followed General Lee until his surrender in April, 1865.

He went to St. Louis in 1869, and in 1871 entered the employ of the Bellefontaine Railway Company of that city as superintendent, was afterwards made secretary, and then vice-president and general manager of the company. He continued in that service until 1889, when Mr. D. G. Hamilton and his friends purchased the Citizens, St. Louis, Cass Avenue, Northern Central and Union lines, and he was made vice-president and general manager of these roads, which position he now occupies.

The meeting was divided into a series of sessions, as recorded below:

Tuesday's Meeting, October 20, 1896.

Welcome by Acting-Mayor Nagel.

Address of President Littell.

Secretary's report.

Reading of paper on "Track and Track Joints, Construction, Maintenance and Bonding," by Mr. M. K. Bowen, superintendent Chicago City Railway Co.

Discussion of paper.

Wednesday's Meeting, October 21, 1896.

Paper written by Mr. John N. Akarman on "Trucks." In Mr. Akarman's absence Secretary Pennington read same.

Visit to the Fair Grounds.

Paper on the "Modern Power House," by Vice-President McCulloch, who is civil and electrical engineer of the Citizens, Cass Avenue and St. Louis Railways, St. Louis, Mo.

Discussion of Mr. McCulloch's paper.

Paper entitled "How can the Revenue of Street Railways be Increased?" Read by Mr. C. D. Wyman, general manager of the Milwaukee Street Railway Co., Milwaukee, Wis.

Visis to Fair Grounds.

Thursday's Meeting, October 22, 1896.

Recess till twelve o'clock to inspect the display of street railway supplies.

Paper read by Mr. Blake, the writer, Mr. B. Willard, superintendent New Orleans City and Lake Railroad Co., New Orleans, La., being absent. Subject, "Modern Overhead Electric Construction."

Report of nominating committee:

President—Robert McCulloch, vice-president and general manager Cass Avenue and Fair Grounds Railway, St. Louis, Mo.

First Vice-President—Charles S. Sergeant, general manager West End Street Railway Company, Boston, Mass.

Second Vice-President—D. B. Dyer, president Augusta Railway Company, Augusta, Ga.

Third Vice-President—C. F. Holmes, general manager Metropolitan Street Railway Company, Kansas City, Mo.

For Executive Committee—H. M. Littell, vice-president and general manager Metropolitan Street Railway Company, New York City.

H. P. Bradford, general manager Cincinnati Inclined Plane Railway Co., Cincinnati, O.

Charles H. Smith, superintendent Troy City Railway Company, Troy, N. Y.

Harry Scullin, vice-president and general manager Union Depot Railway Company, St. Louis, Mo.

George B. Hippee, general manager Des Moines City Railway Company, Des Moines, Iowa.

For Secretary and Treasurer—Thomas C. Pennington, treasurer Chicago City Railway Company, Chicago, Ill.

The officers nominated were unanimously elected.

Address by President-elect Mr. Robert McCulloch.

Mr. President and Gentlemen:—I cannot make a speech, and I will only say that if I had constituted the entire nominating committee, or been the returning board, or if I had carried the electoral vote in my pocket, you would have had a different standard bearer for the ensuing year, and for fear you may think I am not appreciative, I will not criticise your action. I thank you for the personal compliment you have paid me, and the courtesy you have extended to the city of St. Louis; and all I promise you is that while I sit on the executive throne of the association, your banner shall not be trailed in the mire. (Applause.)

Adoption of Niagara Falls as the place of the next meeting.

Friday's Meeting, October 23, 1896.

Paper by Mr. W. F. Kelly, general manager Columbus Street Railway Co., Columbus, Ohio. Subject: "The Selection and Management of Employees."

Discussion.

Vote of thanks to president, vice-president and members of executive committee for their ability and efficiency during the past year.

Committee appointed on "Rules for Conductors and Motormen."

Messrs. W. F. Kelly, Columbus, O.
M. K. Bowen, Chicago, Ill.
E. C. Foster, Lynn, Mass.
Ira A. McCormick, Brooklyn, N. Y.
N. H. Vreeland, New York, N. Y.

Introduction of the new president, Mr. McCulloch.

Meeting adjourned to convene at Niagara Falls the third Tuesday in October, 1897.

In the evening at 8:30 the Anheuser-Busch brewery.

The Banquet.

The annual banquet on Thursday night was a grand success. Three hundred persons were present. The cuisine and floral decorations were all that could be desired; a superb orchestra discoursed music during the service of the dinner and in some of the more familiar refrains the company joined in singing. About fifty ladies graced the occasion. The speeches were exceedingly good, of which the following is a list:

City of St. Louis—Hon. Charles Nagel.

Welcome to Our Guests—Mr. F. N. Judson.

The Street Railway in the Courts—Mr. Smith P. Galt.

The Street Railway as a Social Factor—Mr. F. W. Lehman.

The Press—Mr. W. M. Reedy.

The Technical Press—Mr. E. E. Higgins.

Mr. J. H. Stedman acted as toastmaster.

Opening Session.

The fifteenth annual meeting of the American Street Railway Association was held at the Auditorium Building, St. Louis, Mo., October 20–23, 1896. President H. M. Littell, of New York City, presided, and Secretary Pennington, of Chicago, sat at his right.

The meeting was opened with an invocation of Divine guidance by Rev. P. G. Robert.

President Littell introduced Mr. Charles Nagel, acting-mayor of St. Louis.

Mr. Nagel welcomed the delegates and made a series of witty remarks that went straight home. Mr. Nagel said that he felt compelled to rub his eyes to remember what salt and glanders had to do with a street railroad system. The significance of the change to electric apparatus, fenders, head-lights, etc., impressed him. He mentioned that the association's and cities' interests were one, and likewise said: "We cannot do more for you than we would do for others, because we have a way of always doing our best."

President Littell thanked the mayor for his kind welcome. The roll when called discovered the representatives of seventy-five companies.

The Buffalo and Niagara Falls Railway Co., and the Butte, Montana Consolidated Railway Co., acquired membership in the association.

The minutes of the last meeting were read, and President Littell read the following:

Address of President Littell.

Gentlemen of the Association:

I have to thank you for the honor you have done me in electing me your president.

For the second time, after eleven years of absence, the convention meets in the city of St. Louis—the metropolis of the upper Mississippi—and it receives to-day the same cordial welcome, the same generous hospitality and the same courteous and marked consideration that distinguished our meeting here in 1885; and our first duty is to thank the members of our association in this city for their active and successful efforts in providing for the entertainment of their guests.

I desire also to thank the supply men, in the name of the association, for their very liberal display of exhibits, more space having been taken for this purpose this year than at any convention which has hitherto been held by the association.

The association is to be congratulated upon the fact that during the past year no deaths have occurred in its ranks. We meet here again this year the same in numbers as at our last gathering. Papers of great value and interest will be read upon the subjects of—

Tracks and track joints, construction, maintenance and bonding.

Trucks.

The question of how the revenues of street railways can be increased, taking into consideration the collection of fares, method of registry, transfers, use of tickets or cash fare, and attractions along the line of the road.

Modern overhead electric construction.

The modern power house.

The selection and management of employees.

I will not dwell upon the statistics of street railways during the past year for the reason that these are amply supplied by the street railway press. I have, however, thought it advantageous to lay before you some general considerations on the present and future of street railway interests in the United States, the dangers and difficulties that beset them, the way in which these difficulties are to be met, and the prospect and hope of brighter conditions for the future.

Among the most serious difficulties with which we have to contend today is the growing disposition of the government, whether state or municipal, to increase our burden of taxation. This disposition has increased of late years,

and even within the last year, to a marked degree. The extraordinary prejudice against corporations, among people otherwise intelligent, causes them to be regarded as legitimate objects of attack and spoliation. Those who have once become affected with this prejudice seem to be unable to understand that a corporation is simply a collection of persons, by means of which individual resources, which would otherwise be frittered away in individual enterprises, are brought under one direction, making possible the success of large undertakings requiring an aggregation of capital. Of all corporations those which suffer most from this prejudice are those which exercise a public franchise, and the street railway franchise seems in particular to be a favorite object of restrictive legislation. With the arbitrary limitation of the rates of fare and the obligation of conforming the roadbed to every change in the street through which it passes, on the one hand, and the imposition of direct burdens of taxation in the way of personal taxes, taxes on roadbed, license taxes, franchise taxes, taxes on gross earnings and taxes on dividends; on the other hand, the financial limits within which the workings of a railroad are confined have become exceedingly narrow. Sometimes it almost seems as though the legislative agencies in our various States would not stop until they had brought the burden of taxation to a point where roads could no longer run.

For such a state of things it seems to me that the only remedy is to be found in that gradual enlightenment of the public by which it will be induced to keep the imposition of financial burdens within reasonable bounds, and such a broad-minded and conciliatory management of the roads as shall in time do away with the last vestige of popular prejudice. Any successful business corporation manages and controls forces far greater than those which are at the command of a single individual, and its very power makes it an object of jealousy and attack. But I for one do not believe that the intelligence of the American people will in the long run go astray on this question any more than on any other. I believe that it is beginning to recognize, and will recognize still more clearly as time goes on, the necessity for combination and co-operation in all departments of business; and that if a proper spirit of moderation is shown—and this I consider of the first importance—by those in whose hands this extraordinary power is placed, the community at large will discover that the benefits it derives from transportation corporations far exceed any subject of complaint which it may have against them, and will meet them upon the footing of a common interest without regard to the corporate character of the agency by which the power is exercised.

Another, and one of the severest strains to which street railway corporations are subjected, consists in the penalties imposed by courts for the negligeuce of their employees. Recent years, and especially the last two years, have seen a great increase in the number of negligence suits and in the size of verdicts. There is a marked tendency at the present time, on the part of juries, to fix a higher scale in estimating damages for personal injuries. Cases where formerly verdicts of $2,500 were rendered, now often result in a judgment for $5,000, and others in like proportion. The State of New York has recently removed the limit of $5,000 in cases of death, so that now a verdict of $20,000 in a death case is by no means unusual. The doctrine of contributory negligence, which, in theory and as duly expounded by the courts in charges to juries, would preclude any recovery in cases where it is shown, seems only to be considered by juries—if considered at all—as a slight makeweight against the plaintiff in determining the amount of damages. Probably no class of cases exists in which it is so difficult to meet false testimony as in these, even when its falsity is perfectly apparent.

I do not mean to suggest for a moment that street railway companies are without fault in the matter of accidental injuries, but I do say that, profoundly as we must sympathize with the suffering and the unfortunate, we ought not to be compelled to pay the penalties of negligence where the negligence was due to the sufferer himself, nor should a case be sent to a jury where this fact is disclosed by the plaintiff's own statement. As was well said some time ago by the General Term of the Supreme Court of New York :

"To leave it to a jury to say that such acts under such circumstances do not constitute negligence, would be to throw away the best understood legal standing, and substitute in its place any whim which might chance to flit through the minds or run in the emotions of uninstructed and unbridled jurors."

Whatever may be the result of existing tendencies in courts and juries, we may still hope for improvement in the matter of accidents, as people become more accustomed to the high rate of speed in their streets, which they now exact from street railways. No community which has had the benefit of rapid street transportation would ever be willing to go back to the old five or six-mile an hour rate of horse cars. It must learn and it will learn that it cannot have this benefit without a certain element of danger, and whether it runs the risk of this danger in travelling as passengers on the cars or in walking or driving in the roadway, it will come in time to take those precautions by which the great majority of accidents could readily be avoided.

For those accidents which no ordinary precaution on the part of the sufferer could avert I believe there is one remedy and only one, and that lies in the hands of the management of street railways. That remedy is to be found in *the discipline of the force.* If discipline is slack, accidents will be frequent. If discipline is high and well maintained, accidents will be reduced to a minimum. As in every other great organization the spirit which controls at the top penetrates through all the branches of the system, and the means by which it penetrates is the discipline maintained over the force by its head. In this one element of discipline I believe lies the secret of preventing the ruinous losses which follow from damage suits.

The last two years have seen the introduction of an unlooked-for competitor in street, and especially in suburban transportation, and that is the bicycle. In some places, where its use is peculiarly advantageous, it has undoubtedly cut down earnings very heavily. I do not believe, however, that in the long run the street railway business is going to suffer on that account. Anything to my mind that promotes in our American people the habit of locomotion, particularly of rapid locomotion, is beneficial to street railways. No doubt the bicycle has come to stay, and no doubt upon some suburban routes its competition has been serious, but it is still to a great extent a novelty, and when the effects of novelty have worn off, and the use of the bicycle is limited to those who will habitually make use of it all their lives, I think there will still be found quite enough people who prefer street cars as a means of locomotion, even in places where the bicycle can be used.

In spite of the disadvantages of which I have spoken, under which street railways suffer, and in spite of the financial difficulties which have prevailed for the last three years, and which have told as heavily upon street railways as upon any other interest, I believe they have before them a bright and prosperous future. In their prosperity every man, woman and child in our city communities, and in many rural districts, is directly interested. They have been of enormous benefit in spreading out populations over a larger area, in relieving densely populated districts in cities, and in making possible suburban homes, where the man who pursues his business in the heart of the city can live with his family at a distance from his office, and with them enjoy the benefits of space, of sunlight, of fresh air, of trees and gardens and of rural surroundings. This is especially true of the more modern forms of rapid trans-

portation by which the time of transit is reduced. The luxury of such a home as I have described, to those of moderate means who hitherto have been crowded into small and unwholesome flats or tenements, is one of the many blessings which the modern street railway has bestowed upon the community, and those who have reaped the benefits of it are not likely to forget it.

In conclusion I desire to congratulate the association upon the large number of its members who are present here today, and to express the hope, in which I am sure all of you will join me, that this meeting will be the most harmonious, as well as the most interesting, that we have ever held.

Mr. Green, of St. Louis, moved to have one thousand copies of the president's report printed and entered upon the minutes of the association.

Mr. Baumhoff, of St. Louis, spoke of the early formation of the association, fourteen years ago ; of Mr. Littell as its originator ; of its subsequent growth.

On behalf of the Chicago City Railway Company he presented the society with a handsome gavel. Mr. Littell, in the association's name, thanked the company for their kindness.

The secretary read the minutes of the executive committee held during the year and reported on the membership.

The report of the executive committee showed that the membership in October, 1895, was 173 companies ; eight new companies had joined the association ; three had become consolidated ; one company had withdrawn, and thirteen companies had been dropped for non-payment of dues, leaving the present membership 164 companies.

The committee referred to the fact that at the beginning of the present fiscal year the association was in debt $6,000, and that this indebtedness had been cancelled; and the income during the forthcoming year would be about $6,500, which would enable the secretary to enlarge the scope of the work of the association, it being contemplated that a monthly bulletin shall be issued, containing information of value to the members.

Ethnographers have been accustomed to deal with the "race," the "tribe" and the "nation" as social or anthropic units; but of late it has become evident, says Prof. D. G. Brinton, in Science, "that the 'crowd'—any crowd, anywhere, any time—is just as specialized, has as many individual traits, and is quite as active in its influence, as either of those mentioned. The 'crowd' may be in the salon of a lady of fashion, on a corner in the slums, or at a meeting of a scientific association; it will have the same peculiarities and move according to the same laws. It will act on impulse and not on reason; its intelligence is that of its most inferior members; but its powers are prompt and far-reaching. Mental suggestion and mental contagion are its favorite stimuli. It loves catch-words, symbols, colors and costumes. It prizes a badge far above a syllogism, and can be captured by the former when the latter would fall powerless.—Progress of the World.

Meteorites.—When a very small meteorite enters our atmosphere it becomes incandescent and is visible for a short time as it moves along its path, constituting what is called a shooting star. When the meteorite is larger and when it becomes involved in a denser portion of the atmosphere it presents the appearance of a brilliant planet; it is frequently followed by a *train* of greater or less extent and oftentimes it explodes with more or less violence; it is then called a fire ball. When the meteorite is still larger it frequently escapes destruction in the atmosphere and falls to the earth, either as a unit, or, after one or more explosions, in fragmentary portions; the masses that reach the earth are called aerolites.—Progress of the World.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 108th meeting of the Institute was held at 12 W. 31st street, Wednesday evening, October 21; President Duncan in the chair, and one hundred members and guests present.

The meeting was devoted to a topical discussion of "Electric Traction Under Steam Railway Conditions." It was opened by Dr. Chas. E. Emery. Communications were read from Chas. K. Stearns and Chas. H. Davis. The discussion was then taken up by H. Ward Leonard, Geo. S. Strong, A. E. Kennelly, C. F. Uebelacker, E. E. Ries, Geo. L. Colgate and F. W. Darlington.

It is the intention to discuss the same subject at the Armour Institute, Chicago, October 28.

At a meeting of the Executive Committee held in the afternoon the following associate members were elected:

Sol D. Benoliel, 1327 Broadway; residence, 120 W. 35th street, New York City.

Milton L. Fish, assistant manager, Pasadena Electric Light and Power Co., Pasadena, Cal.

Arthur L. Rice, professor of steam and electrical engineering, Pratt Institute, Brooklyn, N. Y.

The following associate members were transferred to membership:

Frank E. Herdman, mechanical and electrical engineer, Crane Elevator Co., Winnetka, Ill.

M. H. Gerry, Jr., superintendent of motive power, the Metropolitan West Side Elevated Railroad Co., Chicago, Ill.

W. S. Hadaway, Jr., electrical heating engineer, 107 Liberty street, New York City.

NANSEN'S ACHIEVEMENTS.

If Dr. Nansen had carried out his plan to drift across the polar area, reaching open water again, between Spitzbergen and Greenland, the exploit would scarcely have excited so much astonishment as the feat he has actually performed. Had he emerged west of Spitzbergen, with his solid deck beneath his feet, his success would have been largely due to his good luck and the triumph of his theory of the north flowing current. It is another matter to leave one's ship in an utterly unknown sea, at a point never before approached by a vessel within hundreds of of miles, further north than any man had ever before attained, and attempt a dash on the North Pole, with two dog teams and a single comrade. This is what Nansen did; and, wearing woollen clothing "to save weight," in temperatures of 24° to 49° below zero, he made his way almost due north 145 miles, or about 195 miles nearer the pole than the place reached by Greely's party. He was within about 250 miles of the pole when the terrible sledging conditions compelled him to turn southwest for the nearest land; and, when, five months and twenty-two days after he left the "Fram," he reached the eastern shore of Franz Josef Land, he was without a dog, had no food resources except what his gun supplied; and faced the Arctic winter under conditions that would make even an Eskimo tremble. We recall nothing so recklessly daring in Arctic annals, except Peary's incessant pushing to the north for days after he knew he could never retrace his steps from the point he meant to reach unless he found food, which, after all, fell to his rifle only by the merest chance.

Nansen's voyage has demolished the theory that took him north. He admits now, what Greely, Nares and others told him before he started, that the ice drift is largely dominated by the wind. De Long found that the ice mass was driven about by the prevailing winds, with a predominating tendency to the northwest because the prevailing winds are from the southeast. This accords exactly with Nansen's experience. After he pushed the "Fram" into the ice, directly west of the New Siberian

Islands, one year five months and twenty-two days elapsed before he left his vessel. In that time her net advance from the point where the ice drift began was 470 miles to the north-northwest, the distance to the north gained being about 340 miles. She had travelled much further than this, for northern winds persisting for weeks at a time had driven the ice southward. In the long letter received from Nansen he says nothing of his theory of the north flowing current which he so laboriously fortified with arguments; but he does say repeatedly that he found the ice moving with the prevailing winds.

Not the least of the important results he attained is the fact that his theory did not stand the test of examination; and in its scientific and geographic aspects there can be no doubt that Nansen's journey will rank among the most successful of Arctic enterprises. He has done for the western part of the Asian Arctic Ocean what De Long did for the eastern part, with an augmentation of the scientific features of the work that belongs to this latter era of polar research.

Nansen's ship and sledge track being just about equal in the net progress made to that of the Jeannette, the Asian Arctic Ocean has now been traversed far from land by two expeditions, their tracks nearly meeting in the neighborhood of the New Siberian Islands, and then widely diverging. In the eastern segment the little islands discovered by De Long may be equal in extent to the lands found by Nansen, who reports new islands not far from the Asian coast in the Kara Sea and as far east as Cape Chelyuskin, the most northern point of Asia. His route along the coast seems to have been considerably north of Nordenskjold's, for that explorer, skirting the coast quite closely as a rule, discovered many islands there. Nansen, however, found fresh evidences of the glacial epoch, when northern Siberia was covered with an ice cap. This is all the more interesting because Nansen probably knows nothing yet of the striking proofs of Siberia's ice age collected by Baron Toll since the commander of the "Fram" started on his journey.

Neither De Long nor Nansen has found land large or small in the parts of this sea that are more remote from the continents. At the most northern point he reached Nansen was drifting north rapidly, and the ice moved so freely before the wind that there could have been no land to stop it for a long distance. His expedition goes far to confirm the belief that the part of the Arctic Ocean north of Asia contains a very small area of land as compared with other portions of this sea.

Nansen has made one discovery that will greatly surprise oceanographers. Nowhere within the polar area had soundings yet been made indicating that the Arctic Ocean is anything but a comparatively shallow sea. The deepest soundings in the Spitzbergen or Barents Sea are only from 100 to 200 fathoms. Some depths of over a mile have been found in the East Greenland Sea, though most of the soundings there point to a high submarine plateau, with some abrupt depressions. The comparatively few soundings north of our continent show shallow water at a considerable distance from land. But Nansen appears to have discovered persistent depths of 1,600 to 1,900 fathoms north of 79° north latitude, which will tend to upset some theories of oceanic physics based upon the notion of a shallow Arctic sea. He and some of his comrades are sound scientific observers, and the results of their studies in the various lines of research which, Nansen says, he was able to carry on with success, will be received with much interest.

The fact that the party were well and strong after many months of the tedium and hardships of life on the ice pack speaks well for Nansen's régime, and he doubtless attributes this result in part to the success of the electric light plant with which he illumined the Arctic night. He carried a windmill to run his dynamo, and if the wind failed him, he proposed to use hand power. He regarded heat and light as among the best preventives of disease, and he reports that his electric light fulfilled all his expectations.

Nansen believed that the lines on which he modelled the hull of his vessel would save her being crushed, as ice pressure, he thought, would simply lift her to the surface. Arctic experts told him that this might be the case, as long as the "Fram" floated on the water amid the floes; but that her model would count for nothing when she was frozen into the ice, and she might be crushed like an eggshell just as the ice itself is often ground to fragments. The explorer says, however, that when this crisis actually came the "Fram" was slowly lifted out of the bed in which she had been frozen and was not damaged.

Nansen knew that with plenty of powder and ball he was safe, for the winter at least, if he reached Franz Josef Land, for that bleak region teems with big Arctic game. It is to be hoped that his confidence in the ultimate return of his ten comrades, whom he left on the "Fram," will be justified. They have provisions for three years more. There is no doubt that communications will be maintained between Europe, Franz Josef Land, and Spitzbergen every summer for several years to come, unless these prisoners on a tiny Arctic ship are, happily, able to return to their homes without assistance.—The Sun.

MOTORS FOR FIGHTING SHIPS.

The "Industrial Journal" states as follows: "The use of electric motors is clearly on the increase, especially for ventilating, the training of turrets, and the hoisting of ammunition. Perhaps the advantages of electric power over steam are more obvious in the matter of ventilation than in any other field, the principal gain being in the fact that the necessity is avoided for the tremendous air ducts which take up so much room in coal bunkers and living spaces, and the substitution of a number of comparatively small ventilators, each placed where it is wanted, instead of the large steam blowers for which room is so hard to find. The military advantage of the small electric ventilator is one that may easily be overlooked; but it is a well-known fact that in many ships the steam blowers have had to be placed above the water line and absolutely unprotected; which means that in the early part of an action the blower supplying one or more of the magazines may, and probably will, be put out of operation by a very insignificant cause, making it absolutely impossible for the men to remain in the magazines.

"For training guns, the practice of employing promoters is becoming limited to turrets, the mechanism being arranged in such a way that hand power can be used in case of accident. As regards the relative advantages of the three principal powers—steam, hydraulic and electrical—a wide diversity of opinion exists. The great desideratum of simplicity resides, of course, with steam, and many regard this feature as of paramount importance. Others, however, while admitting the superior simplicity of steam, and while admitting the enormous value of simplicity, point out the extreme difficulty of securing a 'dead beat' motion with steam, even if a worm and screw be included in the mechanism. They also point out what at first sight may not seem an important point, but which may readily become so—the question of heating; insisting that no matter what mechanism may be employed, it is after all 'the man behind the gun' on whom we must rely, and that the man behind the gun and the men in the passing rooms will not work at their best in an unendurable heat.

"The principal advantage of hydraulic engines over steam and pneumatic engines, arising from the incompressible nature of water is the absolute rigidity with which they hold the turret.. If the valves are closed the turret cannot move; and the turret can never make the water motor go at a greater speed than that for which it is set. In the sighting hood the continuous turning of a wheel by the operator at any desired speed controls, on the floating level principle, the speed at which the turret shall go. The muscular effort required is so considerable that he is compelled at frequent intervals to move his eye from the axis of collimation of the telescope, which is almost fatal to fine shooting. Now electrical men show that they can attain fully as much nicety and precision by electric means, using a controlling switch so easy to

move that the eye can be kept continuously at the telescope until the instant of fire; and, furthermore, they proceed to point out how pipes burst and valves leak just when called upon to work. In most, if not all of the plans hitherto tried for electrically training turrets, however, control of the motor's speed has been sought through the putting of more or less resistance in the circuit of the armature. The difficulty of handling large turrets by this means is, of course, great, and the means thus far employed can hardly be called satisfactory."

EVOLUTION OF INTERIOR CONDUITS FROM THE ELECTRICAL STANDPOINT.

BY LUTHER STIERINGER, M. I. E. E.

(Continued from page 398.)

With the first installation this question of conductors and their location became one of very serious moment. The method employed was that of a distribution based on a circulation similar to the arteries of the human body, diminishing in size from the source of supply to the points of requirement. Fuses were only applied at the generator, or source of supply, and at the lamp-holders, and were designed for this special protection only. Very few intermediate fuses and cut-outs were used, and these were placed in the most inaccessible and unusual positions, and only on one side of the circuits.

Paraffine-covered wire, as employed in prior telegraph and annunciator installations, was adopted for electric light work. This often became heated to such an extent that it frequently set fire to the insulation, and produced burning wires for long stretches between floors and ceilings and under floors. When this came to the notice of the underwriters, they insisted on a non-inflammable wire, commonly known as the "Underwriters" wire, which had a coating of zinc paint on a cotton fibre braid. This covering, while not being combustible, permitted infiltration of moisture, which caused electrolytic action and the consequent rapid destruction of the wire. Some of the wire gave such bad results in moist places that a twin wire with bituminous covering was substituted. It was known as "Paragon" wire. Much of this for a time gave very good results. The material, however, deteriorated, principally on account of air checks and cracking insulation, and its use had to be discontinued.

About this time various grades of composite and rubber-covered wires of high insulation were introduced with satisfactory results. As in much of the early work done, the wire was supported on cleats and treated practically as if it was bare wire, and as concealed wiring was generally placed in dry structures, defects did not manifest themselves as rapidly as they would otherwise have done.

In the early history of electric lighting, an interior conduit system of wiring was employed. The importance of concealing the conductors in the fixtures necessitated considerable simplicity in wiring to make the same practicable. This was accomplished in the very first commercial fixture, and the general plan then evolved is now in universal use the world over, having completely displaced all attempts to introduce special electric structures.

The attempt of the electrician of that period was to create these special structures just alluded to, based on the lines of his prior practices in telegraphy and other feeble current-carrying arts, introducing contacts, binding posts and other paraphernalia, believing that in this way the whole fixture art would be overturned to make way for the new illuminant. Fixtures, however, are the same to-day as they were before the electric lighting art, except in the modification of the internal portions so as to admit of inserting or withdrawing the conductors and in the angle at which the light can be directed or suspended.

Internally wired fixtures have been and are placed in all kinds of positions. Where the interior of the tubes has been exposed to moisture, the inlets have been closed, thereby preventing air circulation and consequent precipitation of moisture. No appreciable deterioration resulted, even where poorer grades of wire were used.

Gas-pipe or brass tubing, without any insulation, has been the form of conduit in which conductors were placed in fixtures, the only additional provision in a plain iron pipe that was used being in the case of combination fixtures, where the outside of the iron pipe was taped to prevent chafing of the wires. This was abandoned as soon as the manufacturers recognized the necessity of using properly insulated wire and of so constructing the metal covering of the iron pipe as to prevent chafing.

In a paper read before the World's Fair Insurance Congress at the World's Columbian Exposition in 1893, the value of iron conduits was fully recognized, an extract from which is given in the Appendix.

So far as interior electric conduits are concerned, it may be said that they were in use with the first installation, and have been continued, representing the most advanced form of the art, in the large number of fixtures that have been installed. Many of the early plants, such as in mill work, and some of the early expositions have almost as many feet of conductors in the long pipes pendent from the ceilings as there is wiring in the branch circuits.

When it became necessary to conceal wiring, it was common practice to insert mouldings (a legacy of the telegraph installations) in floor beams and put the conductors into the grooves provided. There were also many instances at that time of the separation of gas-pipe lines and of their utilization for the purpose of inserting conductors rather than mar the walls or surroundings by external placement. In the fire-room of the steamer "Pilgrim" in 1883, several hundred feet of brass tube were placed without any insulation other than on the conductors. Several other steamships about that time had galvanized iron pipe as conduits without any insulation. It gave good service.

The use of speaking tubes to serve as conduits was quite frequently in early electric light work. A notable installation of this sort was in a large residence at Greenwich, Conn., in 1887. Although the best electrical talent was employed, the mechanical work did not permit of inserting or withdrawing the conductors freely, and they became more or less fixed in position, with the result that the installation had to be overhauled. In fitting up a cottage on the same premises with electric light, small brass pipe tubing was used.

The users of conduits having a lining of insulation, in order to be consistent, should place only bare copper conductors within them. There is only one insulated iron tube, however, in use at present in which such practice is carried out. This is for underground purposes. A recent installation at Niagara Falls is one of the latest examples of this system. The requirement for insulation of interior conductors is five megohms per mile. In view of this, it can hardly be said that a tube is "insulated" in a commercial sense when, if subjected to the tests applied to conductors, it deteriorates to such an extent as to be practically of no value. Such insulation in conduits is, on its face, of no value whatever to the conductor, which for its efficiency must depend entirely on its own insulation.

Although a period of fifteen years has elapsed since the introduction of the incandescent light, it can not be said that a standard system of wiring, having the elements of permanency to recommend it, has yet been adopted. Cleat, knob, moulding and other makeshift methods, are still resorted to. Similar makeshift practices were in use in the early gas and water installations, such as the placing of the conductors on the outside of walls and ceilings. The concealment and proper placement of such conductors brought about a comprehensive standard of practice that is now nearly universal.

Conduits, when properly devised to protect insulated electric conductors placed within them from mechanical

(Continued on Page 636.)

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CONTENTS.

EDITORIALS
- The Workman's Mite ... 635
- The Incandescent Lamp as a Standard of Light ... 635

GENERAL SUBJECTS
- American Street Railway Convention ... 629
- American Institute of Electrical Engineers ... 632
- Evolution of Interior Conduits from the Electrical Standpoint ... 634
- Frictional and Induction Machines ... 636
- Standardization of the Socket ... 641

MISCELLANEOUS
- Nansen's Achievements ... 634
- Motors for Fighting Ships ... 633
- Some Fuel Problems ... 639

TRADE NOTES
- Chas. J. Bogue ... 638
- Edwards & Co. ... 641
- Possible Contracts ... 643
- Telephone Notes ... 644

PATENTS ... 644

THE WORKMAN'S MITE.

Trades flourish when the hearth is bright; they languish when its flame is dulled. Knitted together beyond release are labor and prosperity; the blood of one is the life of the other. The country is governed by those that work; its interests are theirs and its wealth. The land with rich workmen is a rich country; in it the factory and farm are centres of busy life. What incentive to progress confronts the toiling multitude that sees no hope ahead and in retreat the bleak barrenness of poverty!

Work is our inheritance; it is the best national inheritance; let it then be the field in which to place all valid propositions. The workman's mite keeps him constantly struggling to earn it.

Let us beware lest in truth the *workman's might* becomes the turning-point of all our politics, the unguided and unrestrained power of injured men.

Above all others the coming election is clothed with the garments of gray doubt The workman seeks happiness of home by honest effort, and wants that labor to be honestly paid. The kings of industry are calling their forces into array to crush an erring tendency—a desire to leave the safe haven for the open seas.

The workman needs his mite; the manufacturer needs the workmen. Let neither be guided by the false and theoretical doctrines of a narrow-minded party and both will continue to labor together in harmony and see in the future a brightness that today seems far away.

THE INCANDESCENT LAMP AS A STANDARD OF LIGHT.

The difficulty of measuring candle-power and of securing an absolute standard has kept the field of light measurements upon a somewhat empirical basis. An absolutely steady and reliable light is unobtainable even in a relative sense unless extraordinary precautions are observed.

The suggestion of using an incandescent lamp as a standard of candle-power is being practically carried out by all the lamp manufacturers of the day.

This lamp, however, is not to be depended upon as a standard of the first order. Tests by Ayrton and Medley (Phila. Magazine, May, 1895) have shown an increase in candle-power during the first 124 hours of life in the Edison-Swan lamps, while on the other hand previous experiments with earlier types of lamps have shown a decrease in candle-power during the first hours of burning.

The inevitable conclusion reached, therefore, is that lamps do not constitute the best standards of light. Variations in pressure will so affect the light produced that the inconstancy and irremediable deficiencies become too loudly pronounced to allow of a just continuation of the experiment. To overcome this in part, storage batteries are used. The article headed "Standards of Light" in these pages has the ultimate object in view of showing the relative usefulness of light standards in each particular case. The interesting fact brought to light by the authors, that a change in pressnre of even four-tenths of one per cent. will cause a one per cent. change in candle-power, shows the great difficulties in the way of making accurate measurements.

According to the reports of Lummer and Brodhun (Zeitschrift fur Instrumentenkunde) an error of one-tenth of one per cent. in candle-power tests is only obtained by a variation at the greatest of one-hundreth of one per cent. in current and pressure. The absolute scientific standard of light is most nearly approached by using not an incandescent lamp, but a surface rendered incandescent by the electric current and preserved in its uniformity by the use of storage cells.

Gas Exposition at Madison Square Garden.—A fine exhibit touching upon all departments of the gas industries will be given at the above place and continued for two weeks, beginning Jan. 25, 1897. The Executive Committee consists of the following gentlemen: E. C. Brown, chairman; W. H. Bradley, chief engineer of the Consolidated Gas Co., of New York; Col. W. E. Barrows, president of Welsbach Light Co.; Walter Clark, general superintendent United Gas Improvement Co., of Philadelphia; Emerson McMillin, president of the gas companies of St. Louis, Milwaukee, Columbus (O.), and Grand Rapids, Mich.

Iron Pierced by Hailstones.—One is justified in many cases in giving only a tentative belief to many of the big hailstone tales over which some travellers delight to spread themselves, says the St. James's "Budget." A correspondent in Dholi, Behar, however, sends the indubitable proof of photographs to quite convince us and our readers of the terrible nature of the hailstorms which occurred in his district recently. The storm passed over the greater part of the district of Mozufferpore and Durbungah, but it appears to have concentrated itself with special fury over the indigo factory called Dholi. Here the storm was terrific, even for tropical regions, the hailstones weighing as much as five ounces. On an average they were as large, if not larger than cricket balls. It can be easily understood that the damage done was great. Not a whole tile was to be found in the roofs, trees were uprooted, birds killed, and general destruction wrought all round. What is more astounding, the corrugated iron roofing over many of the factory buildings was riddled as if it had been shelled by a battery. We can quite imagine, as our correspondent informs us, that no storm like it has ever occurred in the district. Hailstones have, however, had the same terrific force in Africa, a sample of corrugated iron pierced in a like manner having been recently shown in London.—Scientific American.

(Continued from Page 634.)

and chemical injury, make such protection absolute, and are accepted by all intelligent architects, engineers and constructors as permanent. Such a conduit, to be practicable, must be a pipe, or tube, of injury-resisting material; as, for instance, iron gas pipe, which has proved its durability in other, more hazardous systems of distribution. The cardinal principle covering all conductors is that they must not allow leaks. The insulation on an electrical conductor, if possessing the property of resisting injury and deterioration, might be considered as self-sufficient. No such insulation, however, has been, or is likely to be developed. There is one other embryo system that may be developed, possessed of sufficiently desirable features to yet become a standard and a rival of the conduit for interior distribution, viz., the solid, or fixed, system, in which the conductors are firmly fixed in position with the insulation in an injury-resisting metal tube, or covering. These can be made of any length, to suit all requirements.

Another form of a solid system is seen in the cable largely in use abroad for underground work. Its lead covering preserves the insulation, and the metal armor prevents mechanical injury. It has been suggested that this cable could be made sufficiently flexible to be installed from outlet to junction and junction to service. There certainly are situations where it can be employed to advantage.

Some years ago what is known as the concentric wiring system was introduced in England, where it is now in extensive use. "In this system the central conductors must be surrounded over their insulation by a metallic sheathing of conductivity equal to or greater than the core." The concentric system has not been employed in this country, although leading electrical engineers have long ago indorsed its practicability and usefulness.

A company recently put on the market an iron tube (gas pipe) with a lining of thin paper impregnated with an insulating compound, claiming for it the same values in insulation that were possessed by thicker paper-lined tubes already marketed, and also claiming the further advantage of a large bore with the same outside diameter of tube. This concern was absorbed by a company manufacturing the heavy paper-lined iron conduit, and since this consolidation the thin-lined tube has disappeared from the market.

(To be continued.)

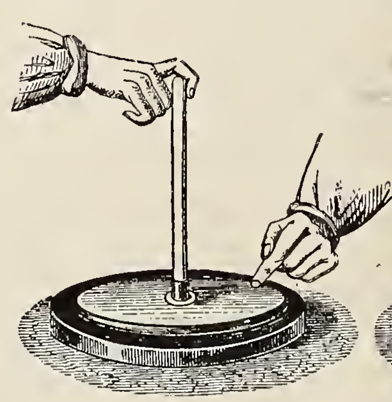
FRICTIONAL AND INDUCTION MACHINES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

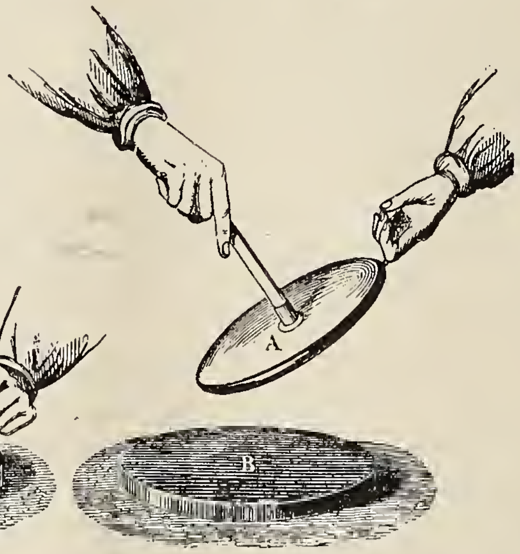
BY NEWTON HARRISON, E. E.

When a pith-ball is brought near a charged body, such as a rubbed glass rod or sealing-wax, etc., the attraction which occurs must be due to some change going on within the pith-ball; otherwise it would not move.

Before the glass rod or sealing-wax is rubbed it has no attraction for the pith-ball whatever, but after friction has been applied and a charge excited it seems that the presence of that charge stimulates the pith-ball to move.

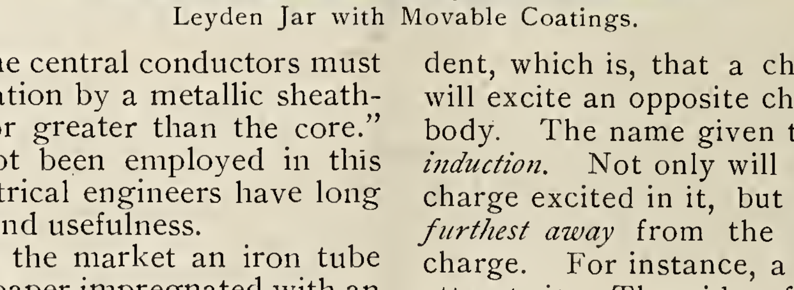


Removing the Free Electricity.



Removing the Charge previously Bound.

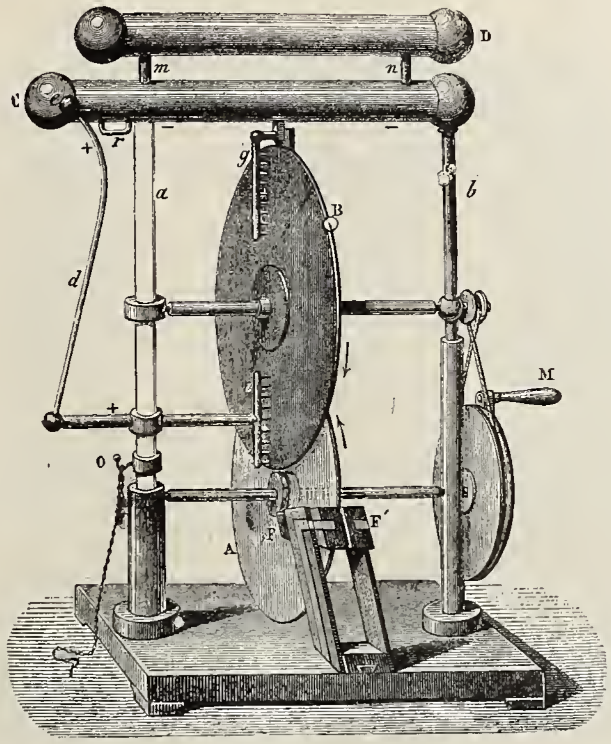
There is no magnetic attraction existing between the two, and no unknown influence other than that spoken of which is affecting the pith-ball, that is, the presence of a static charge. In the last lesson, the final conclusion reached was that only *unlike charges attract each other*. Yet the pith-ball has not touched or been in communication with an opposite charge. There must be one present or the glass rod would not affect it. A pith-ball would not move towards a positive or negative charge unless it possessed a negative or positive charge; and, as we have seen, since no communication has occurred between the pith-ball and any other body, something extraordinary must have occurred by which the pith-ball *without contact* becomes electrified. A new principle is therefore evident, which is, that a charged body across empty space will excite an opposite charge in an unelectrified or *neutral* body. The name given to this remarkable effect is called *induction*. Not only will a neutral body have an opposite charge excited in it, but also on that part of the body *furthest away* from the original charge develop a like charge. For instance, a glass rod held near a pith-ball attracts it. The side of the ball nearest to the rod is negative; the side furthest away, positive. The pith-ball, therefore, possesses at the *same time* opposite charges. Whenever a charged body is brought near an object two kinds of electricity are developed in it, and the two kinds are equal in quantity. Heavy objects that are suspended will not demonstrate the influence of induction, but a light pith-ball responds immediately. The law that opposite charges attract each other causes the negative charge in the pith-ball to move to the side of the ball



Leyden Jar with Movable Coatings.

nearest to the glass rod, and the law that like charges repel each other keeps the positive charge away from the glass rod.

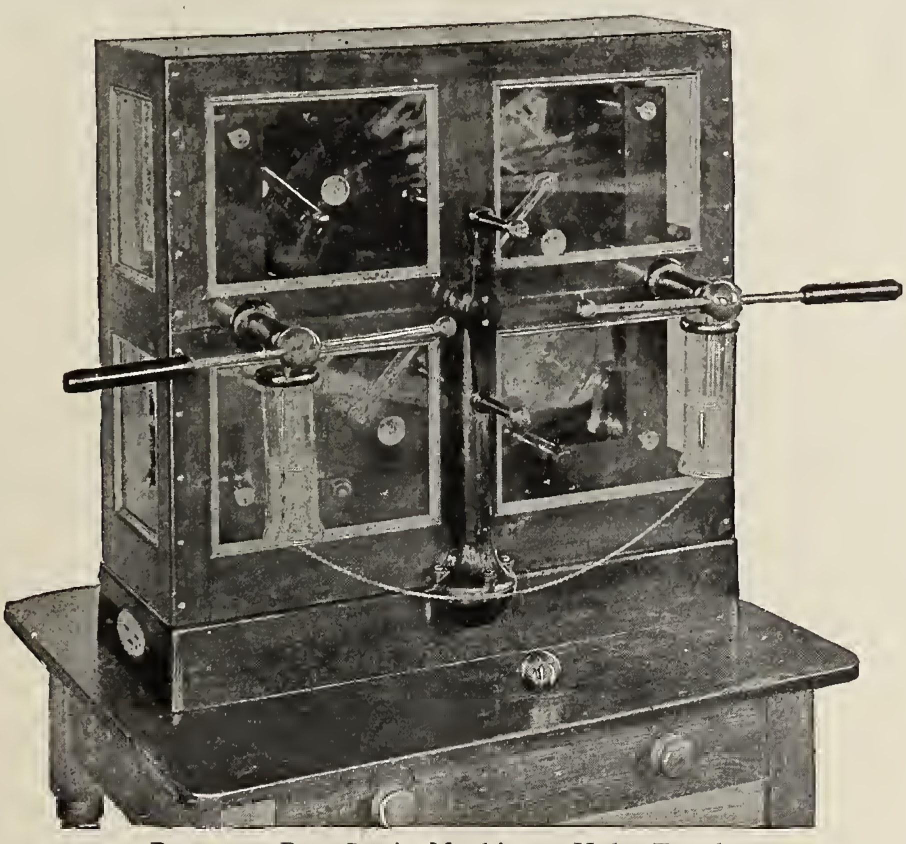
The Electrophorus. This principle of induction is illustrated in the electrophorus. A rubber plate is excited with cat's fur and develops a negative charge. A brass plate, with an insulating handle, is placed upon it. The finger is rested on the brass plate for an instant, then removed. If the plate is now raised by the handle and



Carré Frictional Induction Machine.

the knuckle brought near, a bright spark will be seen. The process may now be repeated without touching the rubber plate. The brass plate put down again, touched, lifted again and discharged. The supply of electricity seems endless, yet the limit is reached when the rubber plate has lost its charge.

The explanation is this : The rubber plate has a negative charge; the brass plate resting upon it touches it



Roentgen-Ray Static Machine.—Holtz-Toepler.

only at a few points, the inequalities of the surfaces separating them by a film of air. Induction occurs and positive electricity is attracted to the *lower* surface of the brass plate; negative repelled to the upper. By touching the plate the negative is removed, but the positive still held. When the plate is lifted the positive, no longer bound by the negative of the rubber, is free to leave. The brass plate develops two kinds of electricity, positive below and negative above; this negative being repelled will leave at once if possible; it is called *free* electricity; the positive is held, and is called while in bondage *bound* electricity; it afterwards becomes free when the plate is lifted away. The action of like and unlike charges, of induction and of free and bound charges is illustrated in the electrophorus.

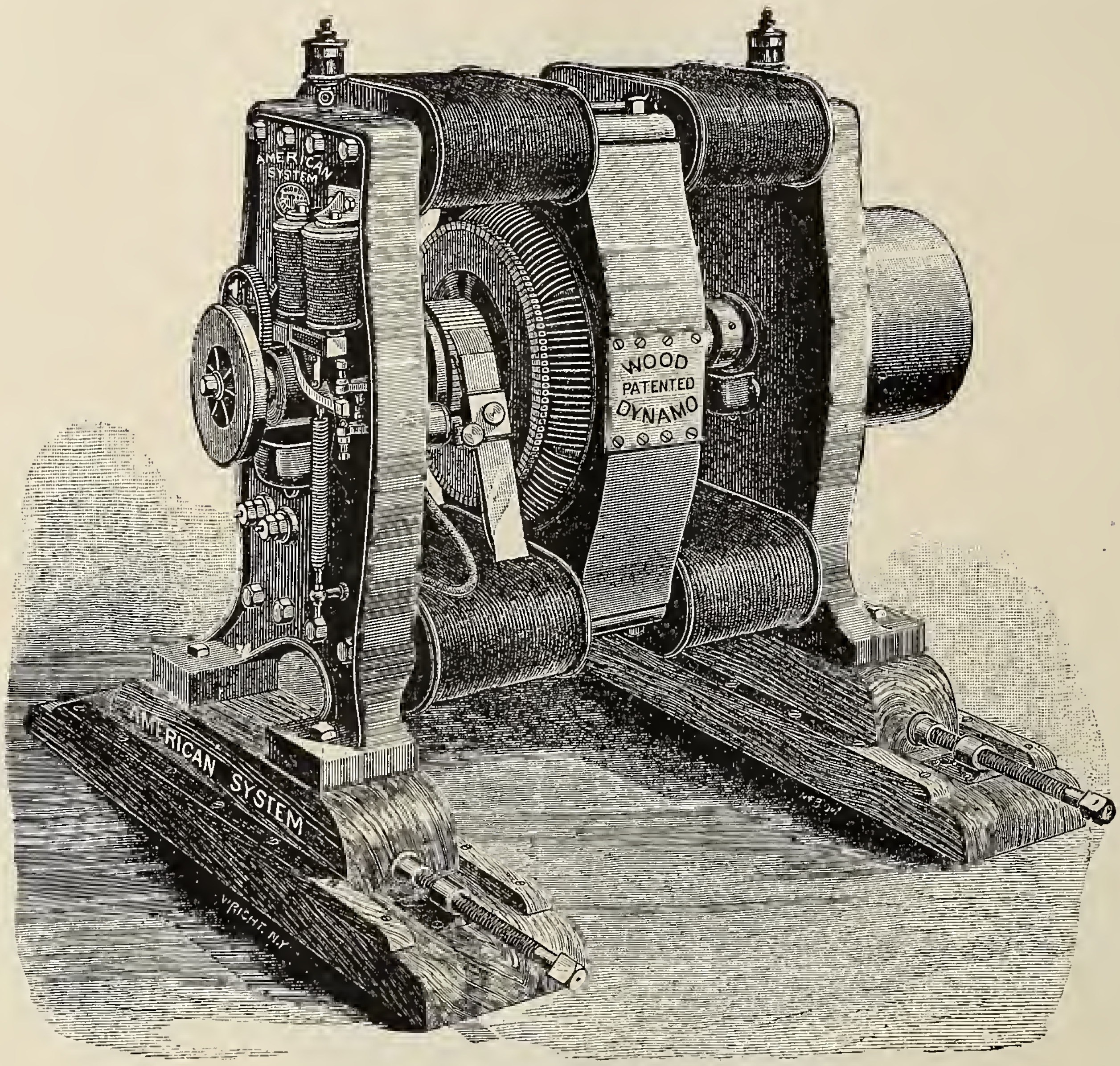
The Leyden Jar, or condenser, merely represents an electrical tank into which electricity is poured until it is full and then discharged. The parts are shown in B, C and D; a glass jar, an inside and an outside metal coating.

Action. The inside coating is supplied with positive electricity; the outside coating is affected by induction. The *inner surface* of the outside coating becomes negative; the outer surface, positive. This positive is *free* and may be taken away by touch; it is being repelled by the positive charge of the inside coating. The negative of the outer coating remains bound, until we connect it with the inner coating; the jar is then discharged.

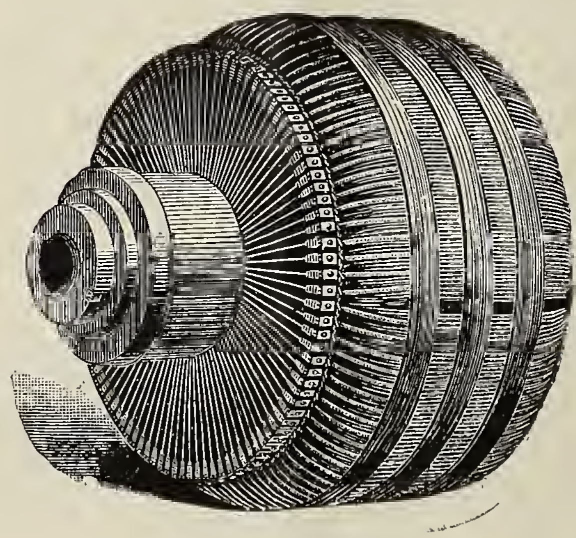
Frictional Machines usually consist of a cylinder, or plate of sulphur, glass, or hard rubber, A cushion presses

upon it and a row of metallic points, nearly touching, supplies the charge as required. The modern form of static machines is based upon the work of Holtz and Toepler; the machine best suited to illustrate the past principles of static electricity is shown in the sketch as constructed by Carré. It combines the frictional with the induction machine.

The Carré Frictional-Induction Machine consists of two plates turning in opposite directions and nearly touching. The lower plate produces a positive charge, because it moves past cushions. The lower comb of the upper plate comb blows positive on the plate and neutralizes the film of negative electricity spread upon it by the lower comb. The lower knob is always positive; the upper, always negative. This type of machine, therefore, combines the purely frictional with the inductive. The lower plate continuously supplying a positive static charge, the lower comb, by induction, blowing negative; the upper comb, positive, thus leaving both above and below on each knob respectively, negative and positive electricity. The upper comb, in addition, serves to clean the plate of any charge that may remain.



The American Dynamo.



Armature of American Dynamo.

is made of metal, and is affected by induction. Negative electricity appears at the comb, and positive at the brass knob. The comb being made of sharp points, blows all its negative electricity upon the plate. When the upper plate turns, this negative passes under the upper comb. The comb is affected by induction and develops positive; the knob connecting to it becoming negative. The upper

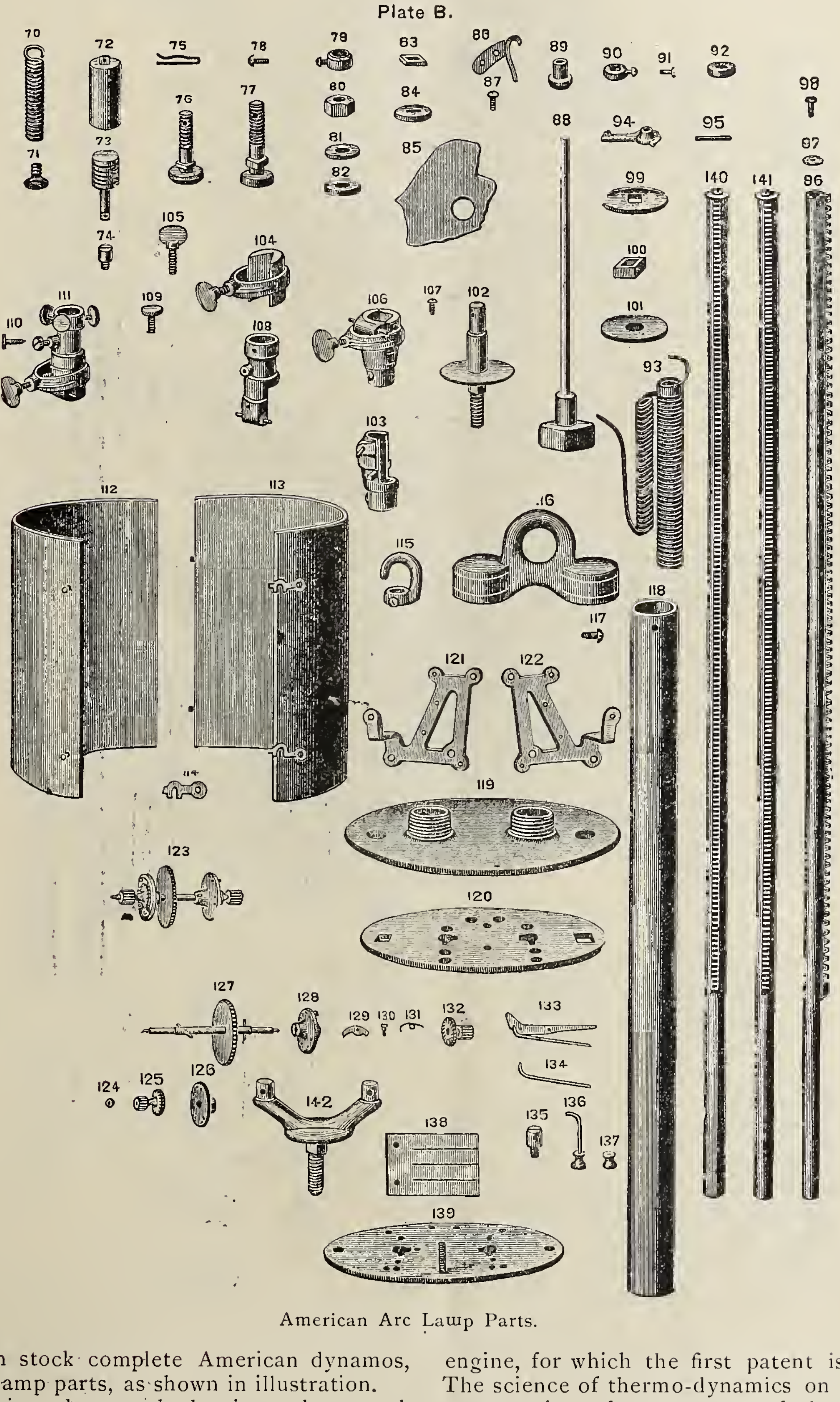
CHAS. J. BOGUE.

C. J. Bogue, of 206 Centre street, N. Y., has for years past been known to the trade for his experience and skill as a manufacturer, and able and rapid repairer of dynamo parts. He makes a specialty of American arc lamp repairs, which includes American armatures and commuta-

ors, all of which are shown in the illustrations below.

The American apparatus manufactured by Mr. Bogue is noted for its economical and efficient operation, simplicity of parts and excellence of design.

Mr. Bogue refills and builds commutators for all kinds of dynamos, and rewinds or otherwise repairs armatures as required. Slate switchboards, lamp hanger-boards and slate insulators for dynamos are also manufactured, in addition to the general electrical repair work carried on by him.



American Arc Lamp Parts.

He always has in stock complete American dynamos, arc lamps and arc lamp parts, as shown in illustration.

Among the American dynamos he has in stock are such sizes as one 75-light 1,200-c. p. arc,

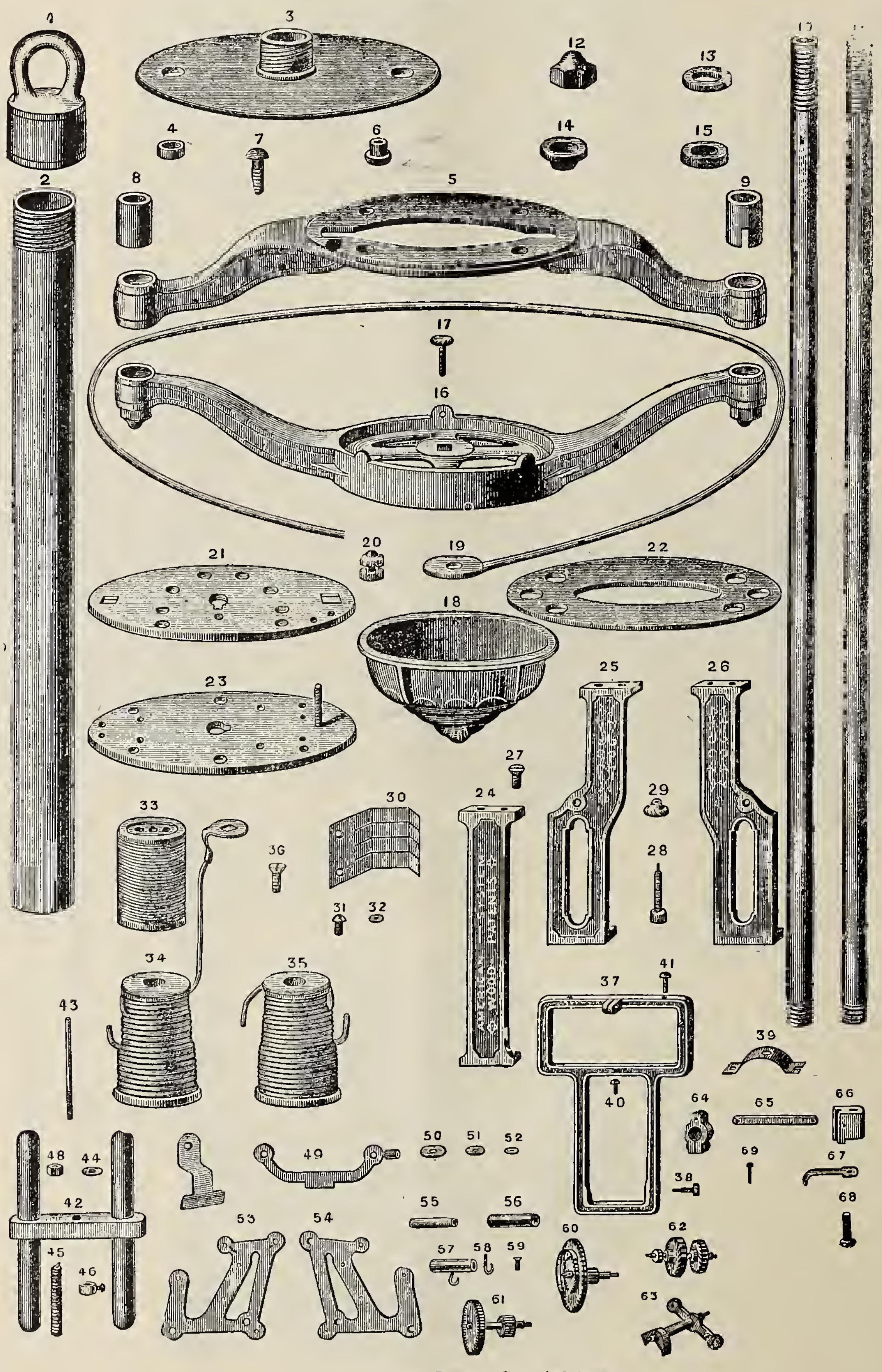
two 50 " 2,000 " "
one 25 " 1,200 and 2,000-c. p. arc,
one 35 " " " " " "
one 25 " " " " " "

SOME FUEL PROBLEMS.

It is not these primary, but the secondary and even more remote effects of fire that have caused civilization to move with a quicker step. While all the marvellous effects of fire, which have been for ages the possession of humanity, still remain as among its greatest endowments, it is as a source of power that fire in the last hundred years has been of such inestimable value. The beginning of its era of power was Watts' invention of the steam-engine, for which the first patent is but 113 years old. The science of thermo-dynamics on the principle of the conservation of energy, one of the most important advances ever made in scientific knowledge, was created as late as the years 1845 to 1855. Even what we have learned in the century just closing as to the power of fire, is as nothing to the stupendous power of this agent that shall yet be revealed.

The world has a vast store of this mineral fuel—coal. How much no one knows. But, vast as are these stores, the consumption in certain countries has been so great that nations have affrightedly asked to know how long the supplies would last. In England the question was discussed by such authorities as Sir William Armstrong before the British Association, Mr. Jevons in his work on "The Coal Question," and in Parliament by John Stuart Mill and Mr. Gladstone. As the result of these discussions, the alarm over the probable exhaustion, in the not distant future, of its coal supplies was so marked that a royal commission was organized, who, arguing from several premises, estimated the duration of the supply at various periods, from two hundred and seventy-six years to over twelve hundred years. But the consumption of coal in Great Britian has increased at a rate much in excess of that upon which the lowest estimate of the royal commission was based. In 1780, about the time the steam-engine was invented, it was some 6,500,000 gross tons a year. It had arisen to 27,000,000 tons in 1816; to 50,875,000 tons in 1850; to 84,042,698 tons in 1860; to 112,875,525 tons in 1870; to 146,969,469 tons in 1880; to 181,614,288 tons in 1890; and to 188,277,525 gross tons (210,870,828 net tons) in 1894. The result of the discussions on the subject of the duration of the coal supply of Great Britian was the conclusion that if the output increases in the same ratio as it has for twenty or thirty years the coal will be exhausted in a little over a century. These estimates are now regarded as excessive, as it is conceded that there is in each nation a limit to industrial development which, without considering the great economies in the use of fuel, will also limit the expansion of coal production. M. Gruner places this limit for England at 250,000,000 tons, which supposes a mining population of a million miners and a working population of five millions.—Joseph D. Weeks, in "Amer. Inst. Mining Engineers."

Plate 4.



American Arc Lamp Specialties.

EDWARDS & CO.

A few of the specialties manufactured by Edwards & Co., 144th street and Fourth avenue, are shown in the accompanying illustrations.

Their electric self-winding clock movements (see fig. 1), operated by a single magnetic impulse every fifteen minutes, has earned a name for itself by its thorough reliability.

A smaller size (fig. 2) with heavy pendulum and second-hand, lantern pinions and dead beat escapement is likewise shown.

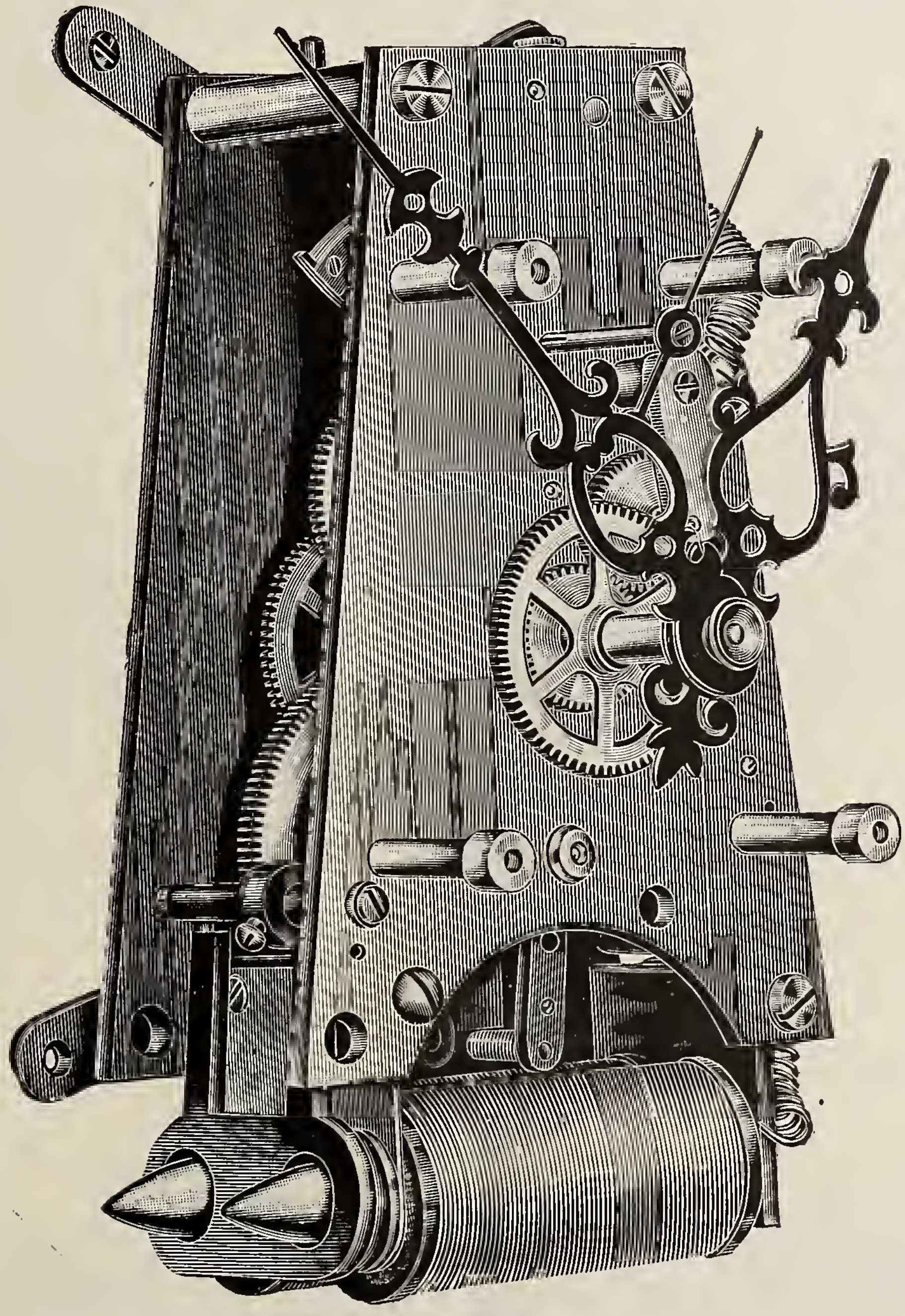


Fig. 1—Electric Self-Winding Clock Movement.

The winding attachment of fig. 3 is the same as the last two, but of lighter construction. It has a short pendulum and lantern pinions, and is well adapted for mantle clocks.

Fig. 4 represents a highly finished movement with fancy dial and hands, solid polished pinions and plates, but with a winding the same as the preceding. They are introducing their clocks in many places with entire satisfaction to customers.

Minutes of a Meeting of Manufacturers of Incandescent Lamps and Sockets, held under the auspices of The National Electric Light Association in the rooms of the American Institute of Electrical Engineers, on Friday, the 9th day of October, 1896.

Present.

Frederic Nicholls, President National Electric Light Association.

Geo. F. Porter, Secretary National Electric Light Association.

Chas. I. Hills, Perkins Electric Switch Manufacturing Company.

W. C. Bryant, Bryant Electric Company.

C. E. Scott, Bristol Electric Light Company, Bristol, Pa.

A. A. Pope, Edison Electric Illuminating Company, New York.

A. D. Page, Harrison Lamp Works, Harrison, N. J.

M. K. Eyre, General Electric Company.

F. M. Hawkins, Electrical Engineering and Supply Company.

A. B. Field, Anchor Electric Company.

C. H. Rockwell, Buckeye Electric Company.

F. S. Terry, Sunbeam Incandescent Lamp Company.

C. D. Marsh, Bryan-Marsh Company.

A. P. Seymour, Pass & Seymour.

S. Wheelwright, John E. Crigal, Newark, N. J.

H. C. Wirt, General Electric Company.

E. E. Ries, New York.

W. F. Hanks, "Electrical Engineer."

C. W. Price, "Electrical Review."

W. J. Johnstown, "Electrical World."

T. R. Taltavall, "Electrical World."

Mr. Frederic Nicholls, president of the National Electric Light Association, in opening the meeting spoke as follows:

"In order that there may be no misunderstanding in regard to the attitude of the National Electric Light Association, I take the opportunity of stating before the business of the meeting commences that on behalf of the association I have endeavored to bring together the several interests here represented for the purpose of discussing the question at issue, and of trying to solve the some-

what difficult problem of standardizing the incandescent lamp socket and lamp base. This association is absolutely impartial, and it was thought that more could be accomplished by holding such a meeting under neutral auspices than in any other way. The object of the association in bringing together such a representative gathering now having been attained, it becomes your duty to elect a chairman."

On motion, Mr. Nicholls was requested to act as chairman and Mr. Geo. F. Porter as secretary.

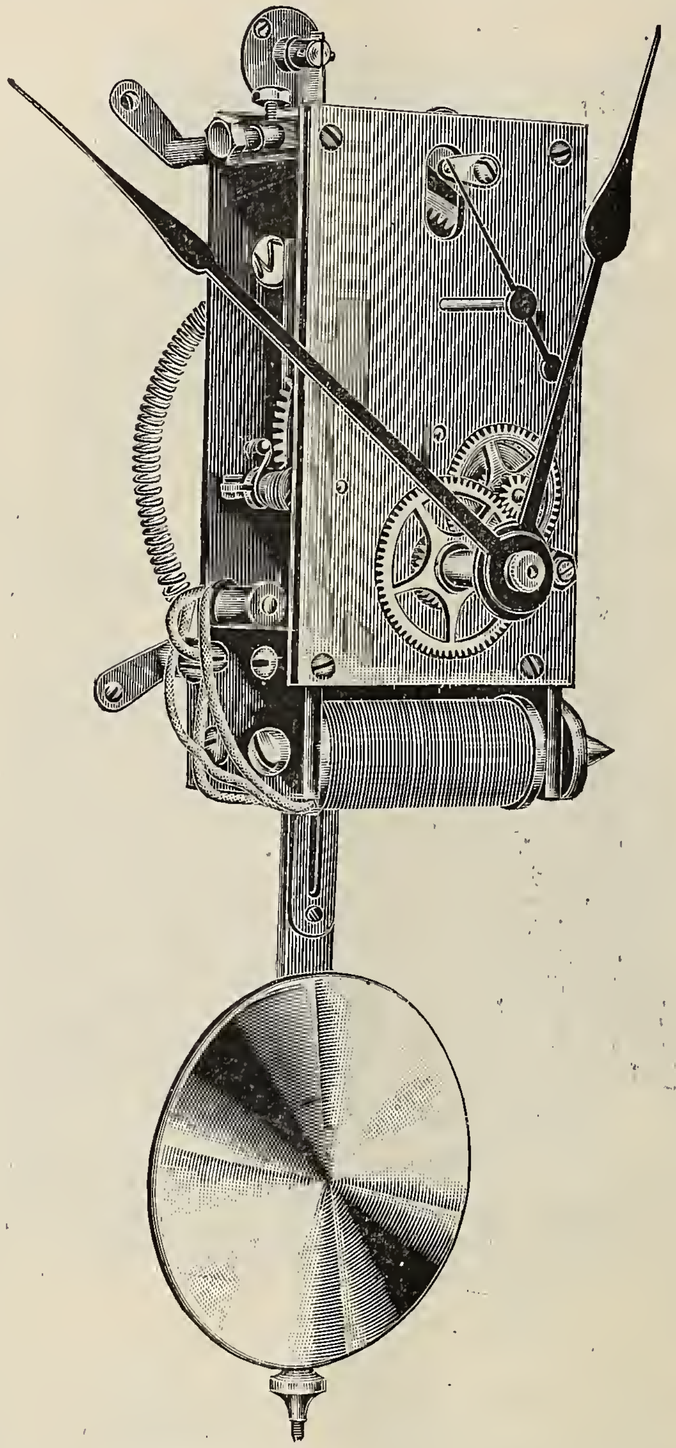


Fig. 2,—Self-Winding Electric Clock Movement.

Resolution No. 1. Moved by Mr. F. S. Terry, seconded by Mr. Hills:

"That it is the opinion of those present at this meeting that a standard lamp socket and lamp base is desirable."

Carried.

A long general discussion then ensued, nearly every gentleman present taking part, and many facts of interest were brought out and seeming difficulties were debated as they arose.

The final results of the meeting are set forth in the following resolutions, which in each case were carried unanimously, it being understood that another general meeting is to be called to receive the report of the committee appointed.

Resolution No. 2. Moved by Mr. Ries, seconded by Mr. Rockwell:

"That before proceeding to investigate the patent situation or licensee question, to obtain the opinion of this meeting as to whether any existing type of socket or lamp base fulfils all the requirements that a standard socket should possess."

Resolution No. 3. Moved by Mr. Terry, seconded by Mr. Bryant:

"That the most desirable lamp base and socket, in itself considered, is a socket adapted for Edison base lamps."

Resolution No. 4.

Resolved: "That a committee composed of Mr. Terry, Mr. Rockwell, Mr. Bryant and Mr. Hills, be appointed to confer with the licensers and licensees of the socket patents with a view to arranging for their general use, and to report back to a meeting at an early date, and that the president of the National Electric Light Association be requested to act as chairman.

A most interesting fact has been discovered by a Swedish scientist. It is that water can be found by boring into granite and other crystalline rocks to a depth of 100 to 700 feet. A well was sunk in the island of Akro, off the Swedish coast, not long ago, and at the depth of 110 feet fresh water was tapped, providing an apparently inexhaustible supply.

Revelstoke, B. C.—Mr. W. Cowan and others give notice of incorporation as the Revelstoke Water-Works, Electric Light and Power Company, for the purposes as indicated by the name.

POSSIBLE CONTRACTS.

Little Rock, Ark.—The petition of the Little Rock Tobacco Company for the erection of an electric lighting plant has been granted.

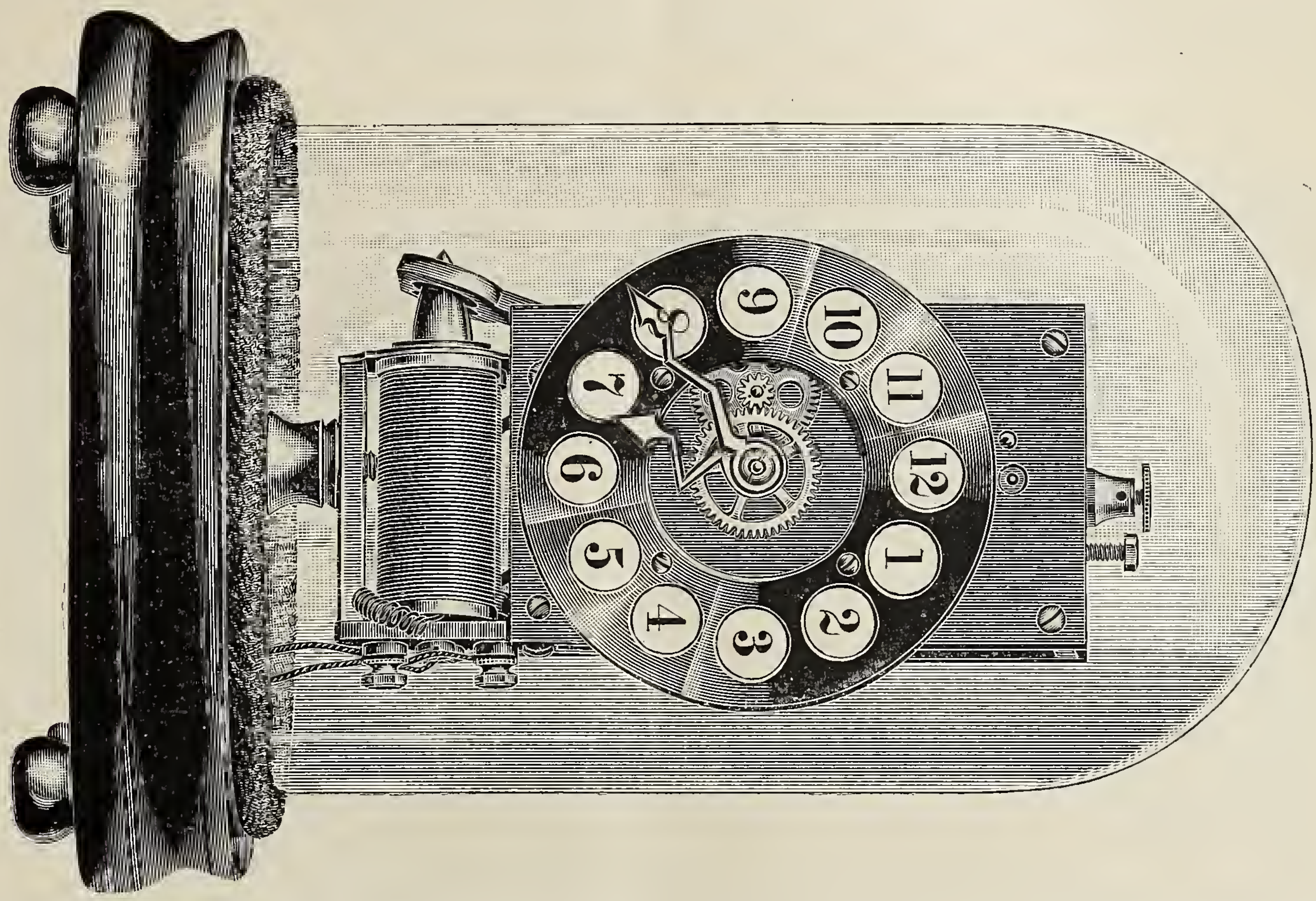


Fig. 4.—Self-Winding Electric Clock Movement.

New Orleans, La.—Permission has been granted to the General Electric Co., of New York, to erect an $80,000 power house.

Okolona, Miss.—$30,000 in bonds will probably be issued by the city for the construction of an electric light plant and water-works. Address the mayor.

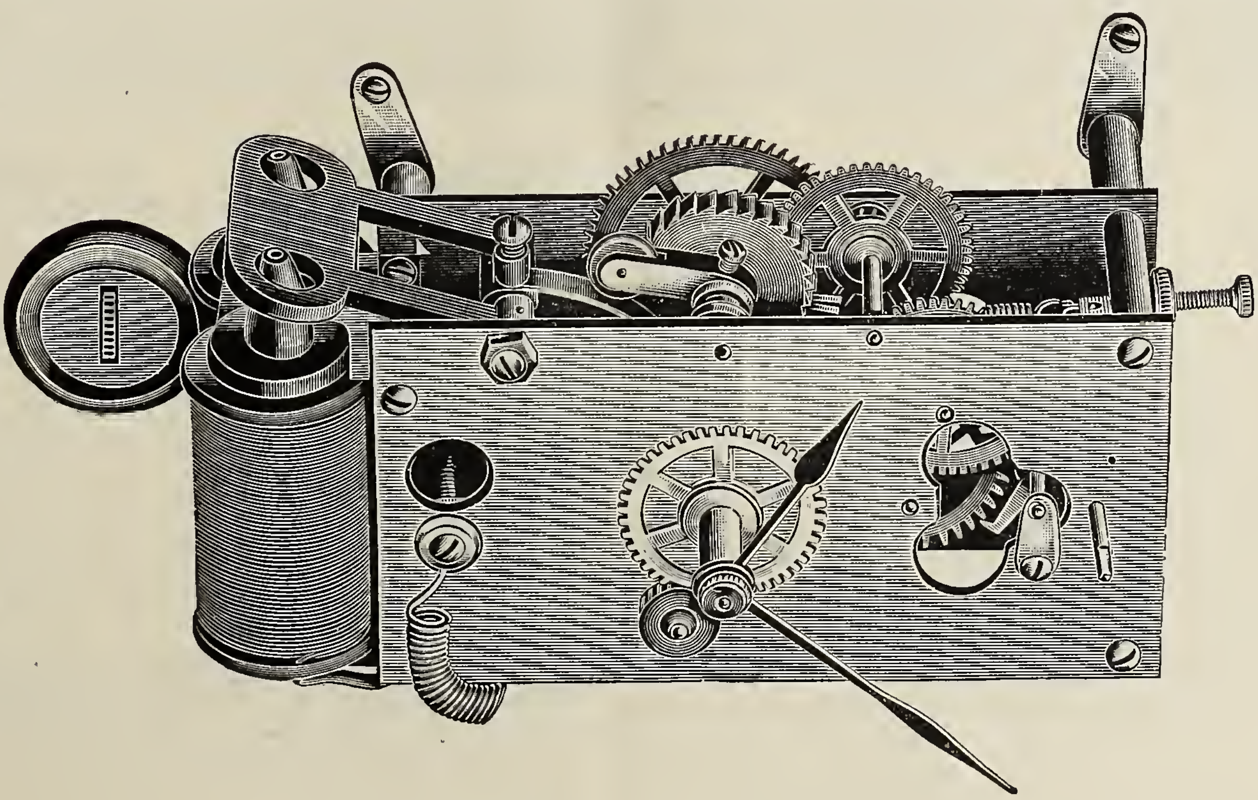


Fig. 3.—Electric Self-Winding C'ock Movement.

St. Louis, Mo.—The erection of an arc or incandescent electric light plant is being considered by the board of public improvements.

Clarksville, Tenn.—The Clarksville Electric Street Railway Co. will erect and operate an electric light plant.

NEW CORPORATIONS.

New York City.—The Fleischhauer Electric Light and Power Company has been incorporated to operate in New York City. Capital, $10,000. Directors, John Keenan, Jacob Fleischhauer and Julius Fleischhauer, of New York City.

St. Louis, Mo.—The Electric Light, Power and Conduit Company has filed articles of incorporation. Capital stock, $50,000. To construct underground conduits, etc. Incorporators, S. M. Dodd, J. C. Van Blarcom and others.

Philadelphia, Pa.—The Harvey Electric Compound Company has been incorporated in Camden.

Rossland, B. C.—The Electric Light and Water-Works Company is enlarging its plant.

Kaufman, Tex.—The erection of an electric light plant in this city is contemplated by the Terrell Electric Light and Power Co., of Terrell.

Terrell, Tex.—The Terrell Electric Light and Power Co. will double the capacity of its plant.

Charlotte, N. C.—Plans have been prepared by F. P. Milburn, of Winston, for the Carolina Mutual Fire Insurance Company's new building, which will cost about $30,000.

TELEPHONE NOTES.

Brooklyn, N. Y.—A new telephone line has been put in at Central Islip.

Florence, Ala.—Work has commenced on the long distance telephone line from Florence to Nashville, via Pulaski. The long-distance line is being constructed by the Southern Bell Company, and will be operated in connection with their local exchanges.

Oswego, N. Y.—Permission is to be granted to the Empire State Telephone and Telegraph Co. to run an underground cable from the west end of the lower bridge to the corner of E. Second street.

Cleveland, O.—The village of Bryan will have an electric light plant before the holidays.

Hartford, Conn.—The Russell & Erwin Company is to build a large addition to the screw factory.

Nicholasville, Ky.—M. A. Anderson and others are trying to organize a company to build an electric plant.

Baltimore, Md.—A plant will be equipped by the City and Suburban Railway Co. near Catonsville, to supply electric power to its Ellicott City branch.

Richmond, Va.—The Richmond Traction Co. has received permission to construct an electric line on First and adjacent streets. Address J. Skelton Williams, president.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued September 15, 1896.

567,586. Dynamo-Electric Machine. G. E. Dorman, Chicago, Ill. Filed February 4, 1896.

567,599. Electric Cut-Out and Annunciator. J. Kipps, New York, N. Y. Filed February 11, 1896.

567,608. Automatic Cut-Out. H. F. Parshall, London, England. Filed July 18, 1896.

567,643. Street Annunciator. H. P. Frear, San Francisco, Cal. Filed November 13, 1895.

567,651. Automatic Regulator for Electric Motors. H. P. Merriam, New York, N. Y. Filed April 28, 1896.

567,688. Telephone. R. F. Rankin, Philadelphia, Pa. Filed October 22, 1895.

567,690. Trolley Catcher. O. R. Sackett, Niagara Falls, N. Y. Filed May 16, 1896.

567,691. Electric Arc Lamp. P. R. Salberg, Allegheny, Pa. Filed January 11, 1896.

567,714. Regulating Admission of Currents to Motors. F. E. Herdman, Winnetka, Ill. Filed December 21, 1895.

567,719. Dynamo-Electric Machine. H. W. Libbey, Boston, Mass. Filed September 16, 1895.

567,721. Method of Producing Electricity. J. R. Payson, Jr., Chicago, Ill. Filed February 24, 1896.

567,745. Commutator. F. J. Haerer and C. L. Gikeleiter, Philadelphia, Pa. Filed April 11, 1896.

567,746. Armature for Dynamo-Electric Machines. F. J. Haerer and C. L. Gikeleiter, Philadelphia, Pa. Filed April 11, 1896.

567,753. Railway-Crossing Signal. C. Selden, Baltimore, Md. Filed April 21, 1896.

567,754. Trolley Contact Device. R. Skeen, Madison, Ill. Filed September 19, 1895.

567,759. Electric Signal. C. P. Wilkinson, Jackson, Mich. Filed December 7, 1895.

567,760. Electric Track Signal. C. P. Wilkinson, Jackson, Mich. Filed December 12, 1895.

567,784. Insulated Cross-Over for Trolley Wires. A. Hanson, Chicago, Ill. Filed April 3, 1896.

567,816. Electric Contact Device. R. Skeen, Madison, Ill. Filed Feb. 17, 1896.

567,818. Electrical Condenser. N. Tesla, New York, N. Y. Filed June 17, 1896.

567,840. Electric Arc Lamp. J. McLaughlin, Chicago, Ill. Filed March 4, 1895.

567,841. Bond for Electric Railways. J. McLaughlin, Chicago, Ill. Filed April 13, 1896.

567,845. Burglar Alarm. W. H. Ward, Mound City, Kan. Filed June 23, 1896.

567,870. Trolley Guard. F. S. Birth, Philadelphia, Pa. Filed November 19, 1895.

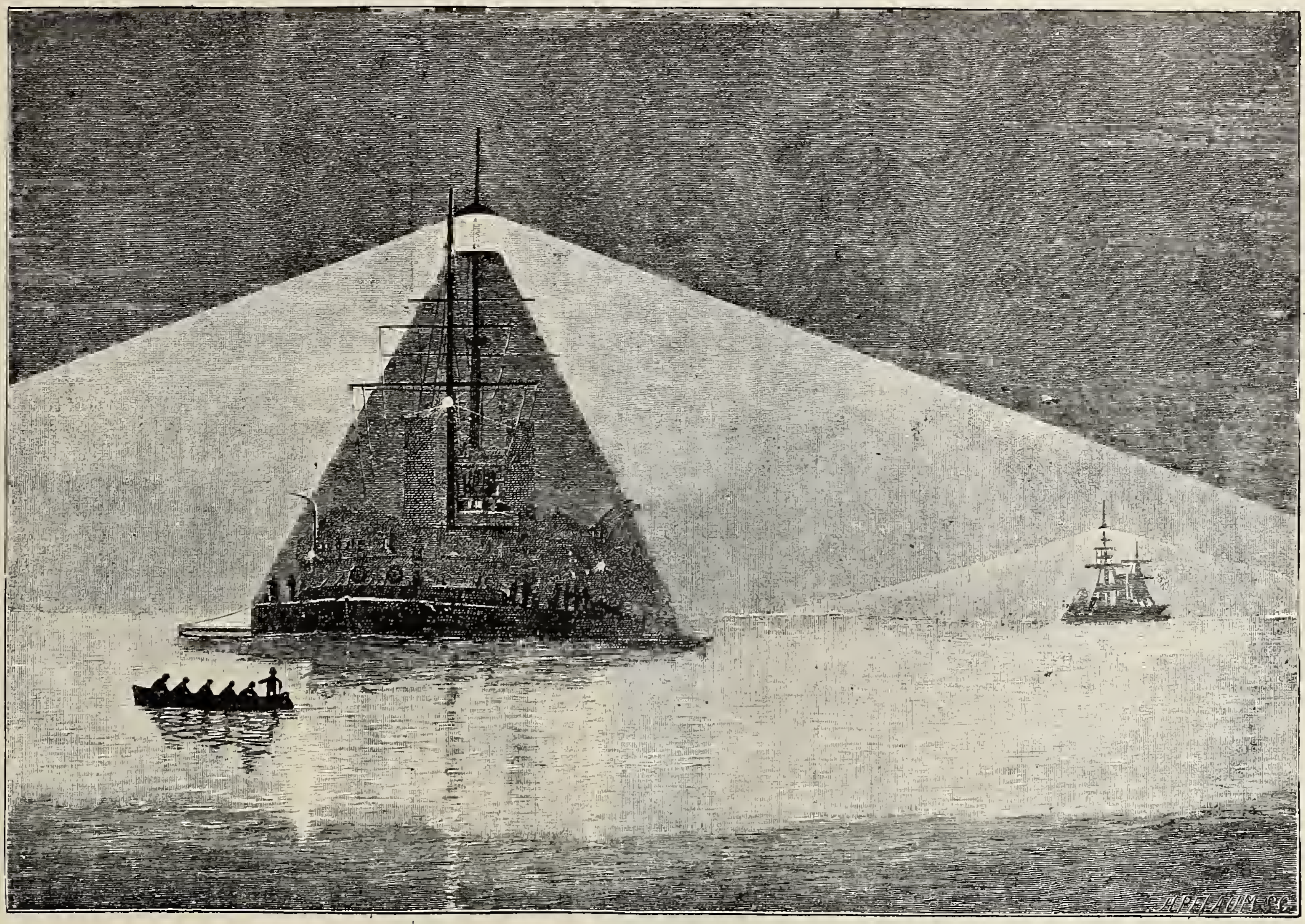
567,899. Contact Device. F. W. N. E. Hayn, Bahia, Brazil. Filed May 14, 1896.

567,924. Interchangeable Electric Sign. W. J. Scott and H. W. Shonnard, New York, N. Y. Filed May 22, 1896.

567,928. Igniting Device. H. Van Hoevenbergh, New York, N. Y. Filed July 1, 1896.

The Electrical Age.

VOL. XVIII., No. 19 NEW YORK, NOVEMBER 7, 1896. WHOLE No. 495



Search Light in the Navy.

THE PROJECTING POWER OF SEARCH LIGHTS.

The means by which signals are sent between distant points includes as one of its most important mediums the search light.

The first brilliant arc that astonished the Royal Society of London would excite but little comment in comparison with the powerful beams projected into space by the search light.

Election night in New York city gave evidence of the power of these new illuminators. One of the great daily papers employed a light of this kind for the purpose of signalling the results of the political campaign. It was perched upon the top of one of the highest buildings down town; when turned upwards, its penetrating power displayed itself by lighting up a dim circle in the clouds above.

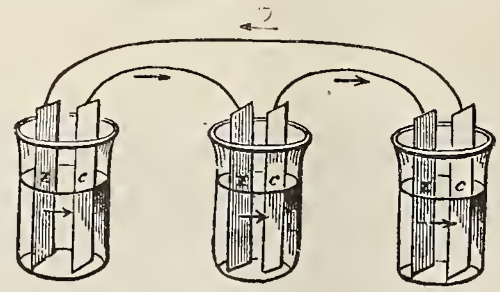
It has been suggested that, for naval or military purposes, its great projecting power would be of inestimable value on certain trying occasions. For ordinary steamers or fire boats an adopted code would enable the captains of the same to communicate with the greatest facility. In the blackness of night the stream of white light seems like a rigid band of material substance instead of the streaming radiance of an artificial sun. On the coast of France a search light of 100,000,000 candle-power is being erected with a distance of projection exceeding 50 miles.

It has been facetiously stated by some one that the only limitation to the space a search light can cover is the interfering curvature of the earth. As light varies inversely as the square of the distance, a search light of 100,000 candle-power projecting a clear image ten miles would have to be increased to the extent of 100,000 x 100,000, or 10,000,000,000 candle-power, to produce the same circle of light over a distance of twenty miles.

UTILIZING THE POWER OF TIDES.

A paper which was recently read before the Institution of Electrical Engineers by Mr. A. Steiger, treating on the utilization of low falls of water for turbines, opened up a question of very considerable importance in certain parts of India. The author referred to a flour mill on the River Stow in England. The mill being at the mouth of the river, the available fall is interfered with by the tide. The maximum fall at ebb-tide is 4 ft. 10 ins., and at high tide the fall is *nil*. Forty horse-power

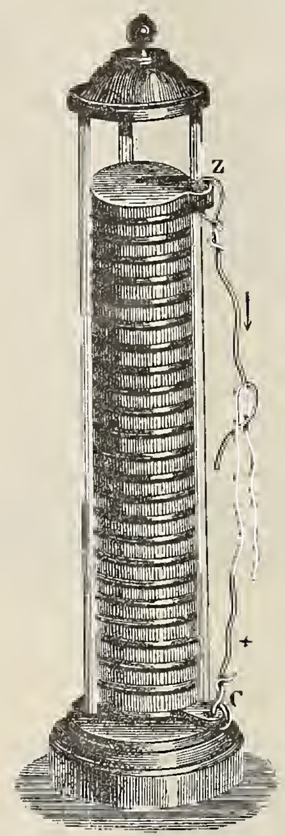
is required to drive the mill, and the contract for the turbine motor stipulated that this power should be maintained down to a fall of 3 ft. 4 ins. It was found, however, possible to drive the mill at full capacity and at full speed under a fall of only 32 inches, and thus the maximum power was available for sixteen hours out of twenty-four; and during a further six hours, making twenty-two in all, power corresponding to a fall of one foot was available by means of a turbine of the Jonval type, having two concentric rows of buckets. The inner row is provided with gates which are opened or closed by means of hand wheels. The outer row of buckets is just large enough to give the full power required under the maximum fall. As the fall decreases the gates of the inner row of buckets are gradually opened to make up the power by an increased quantity of water, and the more water that passes through the buckets of the inner row, the more it acts on a reduced mean diameter, thus maintaining a proper speed without a perceptible loss of efficiency. The speed of the turbine is 24 revolutions per minute, and the outside diameter is 10 feet. Other installations are in operation, and the arrangement seems to offer the most practical solution to the problem of utilizing the power of the tides that has yet appeared.



Simple Voltaic Cell.

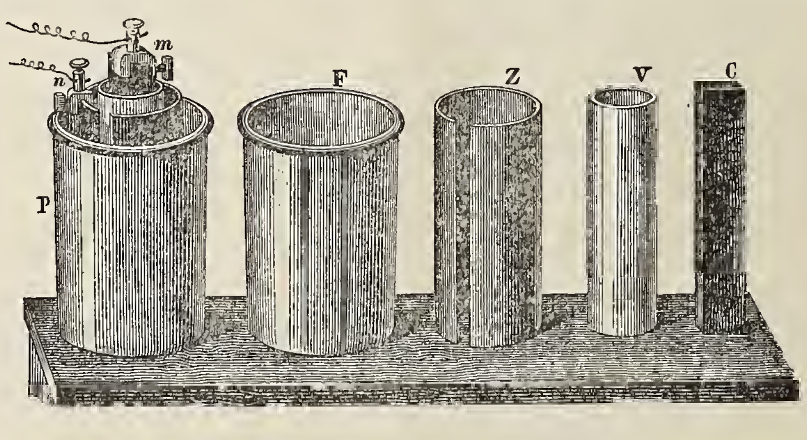
There are many places on the coast of India where the tide enters creeks containing a large volume of water which might be utilized now that a water-wheel of *variable diameter* is to be had which will work when completely submerged. As the current is reversed with each change of the tide, two turbines would be required with suitable gear for changing over with the current.

The grinding of flour, bones, pigments and other materials might be carried out with such an installation; also the sawing of timber and other work.



Voltaic Pile.

The large rivers of India offer very few opportunities for the utilization of their power, as the enormous change of volume and level to which they are subject, and the quantity of trees and vegetation they carry in flood time, preclude all the known methods of applying hydraulic machinery, which, whether submerged or on the surface,



Bunsen Cell.

would be constantly liable to derangement from floating *debris*. It is otherwise with tidal creeks whose volume and current can be easily ascertained and in many cases utilized.

There is another method of using the power of a current of water that may be found on various rivers extending from the Rhone in France to the Kour in the Caucasus. A water-wheel is fixed between two barges or floating platforms which are anchored in the stream. The wheel may be made of any suitable width, and power is taken off both ends of the shaft to drive corn mills.—Indian Textile Journal.

ELECTRIC BATTERIES,

OR

Chemical Generators.

LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

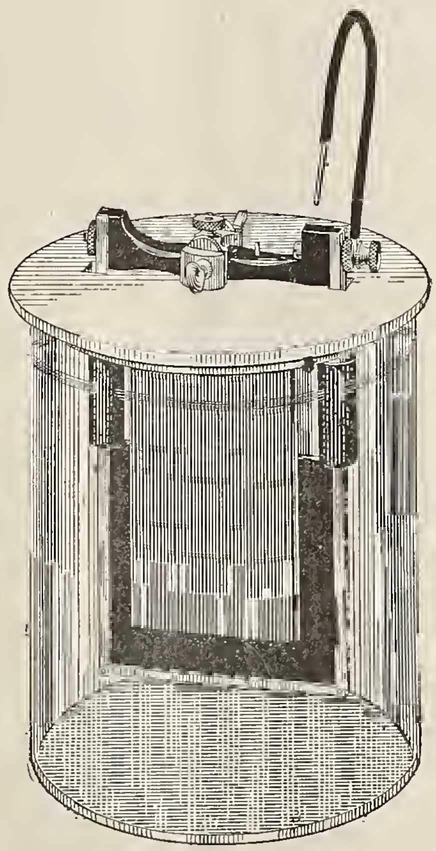
BY NEWTON HARRISON, E. E.

Science has its traditions as well as history ; the most startling developments have followed frequently in the path of an accidental discovery. It would seem strange to say that so trivial an incident as the kick of a frog's leg would be the beginning of a vast series of experiments which finally culminated in the invention of apparatus that today seems indispensable.

Italy has given to us the foundation and starting-point of all that relates to batteries. In the city of Bologna Galvani, a demonstrator in anatomy while testing for the effect of static charges upon the nerves of a newly-dissected frog, accidentally touched its body and leg with a metal instrument. The leg instantly doubled up and twitched violently. All of Europe was aroused at the news and the majority of scientists attributed this activity to the passage of a current from the frog's nerves to the metal; it was called the vital fluid and led to a supposed connection, which exists today, between life and electricity.

Professor Alexander Volta, whose attention was drawn to the experiments and discovery of Galvani, concluded that the *contact* only of flesh and metal caused the spasm. He eventually showed that a similar effect could be produced by two metal pieces moistened at the point of contact ; that is to say, a weak electrical effect proceeded from such a combination. On examination he found that one piece of metal becomes positive and the other negative under such circumstances.

It was but a step from this point to discover the traces of chemical action on one of the two pieces of metal ; to modify them so that the more convenient form of voltaic



Copper Oxide Cell.

pile and battery eventually took their place and settled forever any doubt as to the real origin of the current in such a case. A current may be produced by combinations of Liquids,
Metals.

Two liquids may act upon each other like two dissimilar metals and originate a current of electricity, while it is well known that two metals are the most familiar means of producing a current direct from chemical energy.

It is noticeable that one metal is consumed or dissolved in even the simplest form of battery. A metal like zinc, for instance, which dissolves in dilute sulphuric acid, generates electricity. It will give up all, as quickly as it is produced, to any other metal or element placed in the same liquid with it. This electricity will not flow until the zinc and other element, which may be copper, carbon, platinum, is connected to it by a wire. The zinc, as it were, gives its electrical energy through the liquid to the other element, and it *flows* from this other element outward through the wire to the zinc again.

The simplest battery may be constructed of a succession of copper and zinc plates, round in shape and separated from each other in pairs by blotting-paper dipped in salt and water, or vinegar and water. The arrangement is as follows: zinc, copper, blotting-paper; zinc, copper, blotting-paper, etc.

The moistened metal, that is to say, the zinc plates, are affected chemically.

The two metals are respectively positive and negative to each other when arranged in this manner; the copper being positive, the zinc negative. The list below shows the action of one metal upon another, the one above being always negative to the one below. The metals were immersed in different liquids because it has been found that the attitude of one toward the other is immediately affected by the nature of the liquid in which they are placed.

In a solution of caustic potash and water.	In a solution of hydrochloric acid and water.
Zinc,	Zinc,
Tin,	Cadimum,
Cadimum,	Tin,
Antimony,	Lead,

Lead,
Bismuth,
Iron,
Copper,
Nickel,
Silver.

Iron,
Copper,
Bismuth,
Nickel,
Silver,
Antimony.

For instance, zinc will dissolve in a caustic potash solution and give up its positive electricity to any other metal in the list, such as copper or silver, immersed in the same liquid.

This brings us to a practical point, which is, that a metal dissolving in an acid develops the electrical energy, which passes through the liquid to the other plate and makes it positive. In other words, of the two materials composing a battery one is generally inactive, and acts merely as a receiver for the charge generated by the other.

It may at once be known that a current cannot flow unless there exists pressure to make it flow. This pressure is greater or less according to the materials composing the battery; the current produced merely depends upon its size.

That is to say, a battery having copper, zinc and weak acid for its constituents, will, though no larger than a thimble, produce as much pressure as a battery similarly made of the size of a hogshead. The difference between them would only be that of the quantity of current produced.

Metals, therefore, bear a peculiar relation to each other in this respect. Zinc dissolved in dilute sulphuric acid will in combination with copper, develop a pressure of one volt; the same metal in the same acid, with carbon instead, develops twice the pressure, or two volts.

The pressure developed by two given materials sometimes depends upon the liquid they are in as much as themselves.

Polarization.—The simple cell of Volta consists of a sheet of zinc and copper and dilute sulphuric acid. When the wires are connected to a bell it will ring loudly for a while and then slowly subside, possibly ceasing altogether. On looking in the jars all the evidences of intense chemical action are apparent, and it would seem that enough electricity is being produced to ring the bell as at the beginning. If the liquid is well stirred the bell may begin again, or, by dropping certain chemicals into the jar, the same result may follow. In either case we simply dislodge the bubbles of hydrogen gas which cling to the copper plate and cover it. This gas is reactive and the current cannot pass it; it must be *dislodged* or *absorbed.* It may be treated in three ways—

Mechanically,
Chemically,
Electro-chemically.

A battery is *polarized* when affected by gas bubbles on the receiving plate. The zinc is the *positive plate* but the *negative pole;* the copper, the *negative plate* and *positive pole.*

An arrangement to stir the liquid or force the bubbles of gas from the copper plate would illustrate the *mechanical method* employed as the Smee battery.

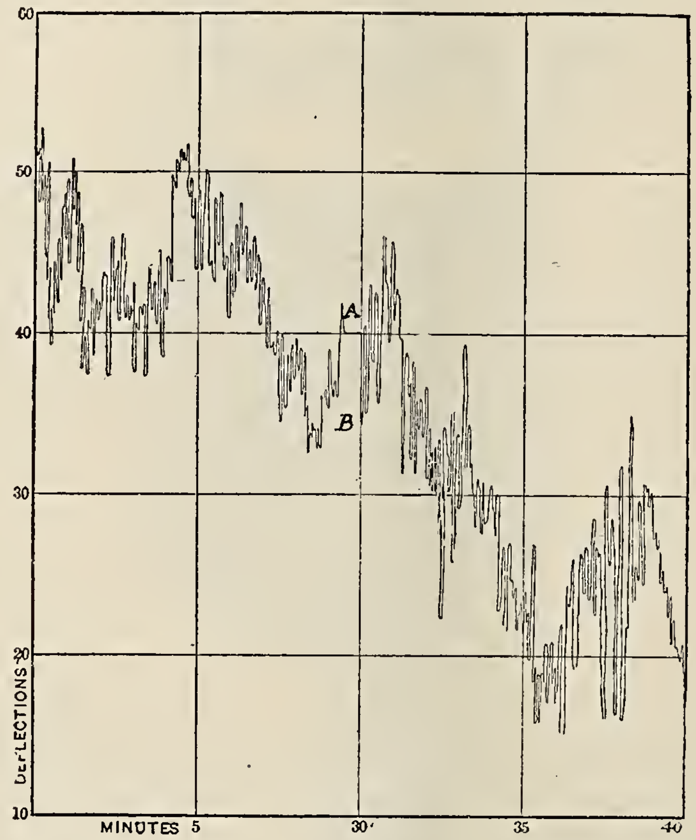


Fig. 16.—Between the points A and B there was a time interval of 20.5 minutes.

As this gas is hydrogen, a chemical which contains lots of oxygen would, when placed in the liquid, allow the two to combine and effect its removal by the *chemical method* as in the Bunsen or Grove battery.

A battery like the gravity or bluestone cell, which by its ingenious arrangement *substitutes* for the hydrogen bubble a particle of copper and allows that to be deposited instead, represents a type covering those employing *electro-chemical means* of depolarization.

Local action.—When zinc is placed in sulphuric acid it will not be dissolved if pure. Commercial zinc is impure and eats away on all occasions, whether the battery is in use or not. We cannot buy pure zinc cheap enough, and therefore have to adopt another expedient.

Amalgamation.—When commercial zinc is covered by a coating of mercury pure zinc passes to its surface. The acid will only attack pure zinc when the battery is being *used.* A coating of mercury on commercial zinc gives it all the advantages of pure zinc and prevents local action.

Cause of local action.—The particles of iron or other foreign material contained in commercial zinc act in combination with the zinc surrounding them like little independent cells, and eat away the zinc in furrows and pitmarks when it is placed in an acid solution. Local action means local electric circuits within the zinc, the electricity being wasted there instead of passing to the positive pole. Amalgamation prevents local action. The use of the three methods described prevents polarization.

Three Rivers, Que.—The North Shore Power Company is being incorporated as an electric power and light company, with headquarters at Three Rivers, for the purpose of supplying electricity for light, heat and power to operate the tramways.

STANDARDS OF LIGHT.

(Continued from page 620.)

XI.

THE BLONDEL ARC STANDARD.

An isolated portion of the crater of the positive carbon of the arc has been suggested both as a primary and secondary standard. The suggestion came from Swinburne and S. P. Thompson independently, in 1892, and in a paper* read at the Electrical Congress at Chicago, the latter urges its adoption as a substitute for the Violle platinum standard.

That the light emitted from the crater is constant in quality and brightness was pointed out as early as 1878, by Capt. Abney. Recent measurements by Violle indicate a constant intrinsic brightness quite independent of the power expended in the arc. His experiments were conducted between the wide limits of 10 and 400 amperes and corresponding power values of 500 and 34,000 watts. Throughout this range Violle found the spectro-photometer to show no variation in quality of light emitted—a result which was corroborated by a photographic method. These results led Violle to announce absolute constancy in the temperature of the crater surface—a constancy which he believes to be due to a true ebullition of the carbon at this point. This view is in accordance with that advanced by S. P. Thompson.

The temperature of the positive carbon Violle has determined to be 3,500°. This value, obtained by a calorimetrical method, must be considered as only approximate, owing to lack of knowledge of the specific heat of carbon at this extreme temperature.

To Blondel† is due the first attempt to put this standard into a working form. In the form of lamp adopted by him, an obliquity of 40° to 60° from the vertical is given to the crater surface by inclining the carbons about 20° from the vertical. The extent of the incandescent surface exposed is regulated by a diaphragm pierced by holes of different sizes, any one of which may be brought behind an opening in the screen by a simple rotation. The screen is cooled by a stream of water as in the Violle standard. For arc light photometry an opening of one square millimetre is recommended. The illumination on a screen 4 m. distant is then about 10 candle-metres. The best results are obtained by maintaining an arc of 5 mms. with a current density of 0.2 ampere per square mm. It is, of course, essential that the operator satisfy himself that he is getting light from the region of maximum brightness before making a photometer setting.

Upton Focusing Lamp.

This is insured by momentarily dropping a small lens in front of the hole and projecting an image of the carbon points upon a screen placed at right angles to the photometer bar. Blondel has determined the intrinsic brightness of this source to be 158 candles—the extreme figures in his measurements being 150 and 163.

With reference to this standard, a question of paramount importance is that of the influence of the quality of the carbons upon the intensity. Since the impurities are volatilized at a relatively low temperature, a surface of pure graphite is left as the light-emitting coating of the crater, and it might be supposed that moderate variations in the quality of the carbons would be without effect on the intensity of the light emitted. Blondel's researches in this direction indicate the contrary. For cored carbons he obtains values as low as 130 candles for the intrinsic brightness. Even with homogeneous carbons there is a considerable variation—so much, indeed, that the utility of the device for anything but a secondary stardard for arc light photometry is exceedingly doubtful.

Bolometric curves of an improvised arc standard consisting of a Schückert focussing arc lamp with oblique carbons, in front of which a diaphragm was mounted, are shown in Fig. 16. It would not be fair, perhaps, to claim that in this experiment the conditions proposed by Blondel were successfully fulfilled. It may be said, however, that a reasonable attempt was made to do so on the part of practiced experimenters. The range of the sudden fluctuations which the curve exhibits may be taken as indicative of the difficulties which those are likely to encounter who use such a standard.

* "Proc. of the International Elec. Congress," p. 267.

† Blondel, "Proc. International Elec. Congress," p. 323.

FOCUSING LAMPS.

The Upton focusing lamp for photo-engraving, or other work requiring a powerful light, particularly recommends itself to theatrical people, photographing establishments and any other use requiring a steady illumination.

This lamp has features that make it better than any other yet produced. It can be turned to any angle from straight overhead to directly down, and is so arranged that it can be turned in any direction horizontally. It can be governed by hand or automatic feed, at the will of the operator. It can be burned two in series on 110 volts on direct current. It is also made for the alternating current. We can highly recommend this lamp as suiting all cases where one of this description is necessary. By the arrangement of the lenses, objects can be focused very sharply. It is light and easily moved from one position to another. They make as an accessory to the lamp, color slides for stage work. This lamp is well adapted for lodge-room work. Special lenses and reflectors furnished on specifications.

Sold by Chas. A. Bramhall, New York agent, 39 Cortlandt street, of the Standard Thermometer & Electrical Co., successor to the Standard Thermometer Co., of Peabody, Mass.

When motors were first placed upon street cars it was believed that there was no necessity for special construction, or any marked departure from the prevailing horse-car practice. The idea of a separate truck had not even been conceived. We found Vandepole placing his motors upon the front platform, and using chains and sprocket wheels to carry the power to the axle. The car carried the whole weight of the motor and load, and in addition to its usual work, took all the strains of the propelling power. Sprague made a short step in advance and in the right direction by carrying his motor on links from the car body and resting one end, through sleeves, on the axle. This improvement preserved the distance always the same between the motor and the axle, but the rising and falling of the body imparted a racking motion to the motors, which was destructive to the cars. Both of these systems were radically wrong, and might have been known to be so from a study of the steam coaches of fifty years ago, and from the steam wagons of fifteen or twenty years previous. As a result, hard riding cars were produced which soon wore out. It was also found that a car body was put out of service whenever there was a necessity for any repairs to the motor or machinery.

It was at this point that the idea of a separate truck was thought of. It was not, however, thought of with

Upton Focusing Lamp.

STREET RAILWAY TRUCKS.

JOHN N. AKARMAN.

After a long and expensive experience it has at last been generally conceded that trucks are necessary for carrying a modern street car. The term truck in this case means the separate framework for holding the running gear of an electric car; namely, the wheels, springs, brakes, motors, etc. This being the case, the question arises as to what form or type of truck is best adapted to the purpose, and the object of this paper is to endeavor to give some hints to street railroad men which will enable them to solve this question themselves. In doing this, it will be necessary to explain the principles involved, the requirements of the service, and show where single and where double trucks are most desirable.

any favor, as months were spent in an attempt to get an electric manufacturing company to try the new system and put a separate truck under the body of a four-wheeled car without success. The idea of a separate truck was first conceived about the year 1885, but it was not until the latter part of 1887 that, in its concrete form, it was put into operation.

The first truck consisted of a continuous upper cord made of bar iron in the form of a rectangle. Its purpose was to support the car body, the sills of which rested on its frame. The sides of this upper cord were re-enforced by heavy oak sub-sills, to which the cord and the pedestals were both firmly bolted. This form of frame kept the body square and took many of the strains on itself; but it has been abandoned, and in abandoning and using

(Continued on Page 652.)

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CONTENTS.

EDITORIALS
- Stereopticons 651
- Mist 651
- Back E. M. F. of an Arc 651

GENERAL SUBJECTS
- The Projecting Power of Search Lights 645
- Electrical Batteries or Chemical Generators 647
- Standards of Light 648
- Street Railway Trucks 650
- Evolution of Interior Conduits from the Electrical Standpoint 652

MISCELLANEOUS
- Utilizing the Power of Tides 645
- The Limits of Science 651

TRADE NOTES
- Focusing Lamps 649
- Zimdars & Hunt 653
- Edwards & Co 654
- American Engine Co 658
- Bergmann Long-Life Arc Lamps 656
- Electric Stock Quotations 659
- Canadian Letter 659

PATENTS 660

STEREOPTICONS.

The steps of evolution betray themselves in the development of mechanism as well as life. The popularity and spread of the kinetoscope, or its many variations, is due to a large extent to the perfection of the focusing lamp. It was difficult at first to create even a limited field for this apparatus among the photo-engravers of the city, but now its application has extended, its demand has increased and in the stereopticon, kinetoscope and engravers' studio the lamp is a familiar sight. From the stereopticon with its improvements and perfection the kinetoscope crops into view. The focusing lamp, the stereopticon, the kinetoscope, phantascope, vitascope, etc., represent the stages of finished growth. How the series will end none can determine. The art of instantaneous photography, the use of interminable gelatine films, have brought a beautiful physical principle into crystallized form. These new stereopticons will never lose that fascination which a perfect simulation of life and motion will always possess.

MIST.

One of the most celebrated of our daily papers, in a recent editorial, headed one of its worthy criticisms with the title "Fog."

Now that the politicians have either executed their aims or themselves, we think it time to blow away the commercial mist hovering over us and set the wheels of industry agog. While it is neither honorable nor creditable to crow over a defeated party we believe our friends to have been in error, to have been opposed by the brain and brawn of the country. They should therefore wait and work with the same earnest interest as ourselves for the common weal. The fog and mists of political quagmires have passed—both the sodden soil—with the flimsy mist. With clearer sight and unequalled energy let us rebuild once more the shaken structures of an interrupted prosperity.

BACK E. M. F. OF AN ARC.

The back pressure created in an arc has been ascribed by some to the effect of a pseudo-electrolytic action, an electro-thermal effect, or the result of circumstances whose conjoint action arouses an opposing pressure.

Of the last but little can be said having any definite bearing. The terrific heat, however, and the difference of temperature between one terminal and the other is by some authorities supposed to represent the *prima facie* cause of counter-pressure.

The electrolytic effect has in it the factors familiar to the lay student. In fact the word electrolysis is almost the synonym of back E. M. F. But of late certain theories have been aired, backed up by reasonable experiments, which show the extraordinary electrostatic pressures produced by the difference of high temperatures. There is then some basis for the belief that back E. M. F. in an arc may have its origin in the heat differences between the two incandescent carbon tips.

The heat of the points is increased by decreasing their size. According to Rosetti, the temperature of the + carbon is 7,000° F., and of the — carbon 4,500° F. The resistance of the arc or heated space is from one to twelve ohms.

THE LIMITS OF SCIENCE.

President Mees, in his address before Section B (Physics) of the American Association for the Advancement of Science (printed in the last number of Science) states that the progress of science "may be expressed by a curve approaching truth asymptotically, probably never in human experience approaching to its *complete* knowledge. So long as investigators find that they are working upon the steep part of the curve where it approaches truth rapidly, there is no lack of interest; this, however, seems to die out quickly when much labor and great patience are required to extend experimentally the curve now more slowly approaching complete knowledge, or straighten out some of its irregularities."

I should myself regard the progress of science from a very different point of view. Knowledge does not seem to me to approach final truth as an asymptote, but rather to be an irregular sphere in endless space. The more we enlarge our little sphere the greater is the surface at which our knowledge touches our ignorance. The more we learn, the greater is the area immediately awaiting exploration.

It is true, as President Mees states, that a man or group of men of unusual insight carry forward our knowledge, and the details must be filled in until the average has arrived at the point reached by the positive variations. Then new positive variations carrying our knowledge further are more likely. But there has never before been a time when it was possible for a man of genius to make such great advances and in so many directions.

J. McKean Cattell.

Columbia University.

The post-office in London has pneumagrams for its own use and convenience, but this system of sending short messages is not open to the public; although, as "Lightning" observes, messages might be sent by the existing pneumatic tubes at a cheaper rate than by telegraph, and it would pay the post-office a handsome profit. The system might be adopted in all large towns and extended enormously in London. It has been long in operation in Paris and Berlin.

(Continued from Page 650.)

separate bars, I think, we have been drifting away from the best practice, for it had a very important advantage in preserving the squareness of the body and truck. In addition to this upper cord, there was a bar extending around the truck to which the bottom of the boxes were fastened.

In all the early trucks the frame rested directly on the journal boxes. The jar and concussion which resulted crystallized the metal, injured the motors, and made it impossible to keep bolts and nuts tight; and was the cause of a rapid destruction of the whole truck. A remedy became an imperative necessity. So elasticity or cushioning of some sort was resorted to; and the first effort in this direction was made by placing a thick piece of rubber upon the top of the journal box between it and the axle-box frame. While the principle was right, the means employed was of little value. The rubber at best had only a trifling elasticity, and was not durable, and did not prevent the box from jolting.

Then a spiral spring was tried upon the top of the box. This was an improvement, as it had a certain amount of motion; but the space available over the box was so small that a very stiff spring had to be used. So stiff, in fact, was it necessary to make the springs that they were but little better than the rubber. In many cases the springs used were so rigid that they were no better than the old uncushioned construction. It was found that springs in this position had the additional disadvantage of aggravating the rocking of the box from side to side; but by widening the box at the bottom, or adding ears so as to form spring seats, it was found possible to give each box two springs, one on each side, and of ample diameter and length so that they would carry the load with ease and have sufficient motion. Thus placed they had the advantage of carrying the box perfectly steady, preventing entirely the rocking and unsteady motion. (It should be noted here that the motors were carried on the truck, and were in no way attached to the car body nor connected with its motions.)

So far as I can learn, the first car body carried on a separate four-wheeled truck was run on the Scranton & Suburban Railway Co., in Scranton, Pa. About the same time the Boston and Revere Beach Railway Company, in Massachusetts, had a car, the body of which was mounted upon a truck; from the frame of the latter the motor was carried in the modern fashion. This car was operated under the eyes of the officials of an electric railway company, who watched its operation from day to day with the most careful attention, and it required but a few weeks of service to demonstrate that the principle was a great one, and that a very important advance had been made that was to mark an era of success in the operation of electric cars.

(To be continued.)

EVOLUTION OF INTERIOR CONDUITS FROM THE ELECTRICAL STANDPOINT.

BY LUTHER STIERINGER, M. I. E. E.

(Continued from page 636.)

An interior electric conduit of steel, thinner than ordinary gas pipe, with brazed seams, is being introduced. It is undoubtedly intended to be lined with paper similar to the iron-pipe conduits now made by several firms. The special advantage claimed for this steel tube is its cheapness. A large amount of similar tube has been in use for various purposes for some time. Experiments are now being made by various parties with steel and mild steel tubes of injury-resisting qualities and in special forms and fittings, with the idea that they can be produced at a cost lower than gas pipe, and, if found necessary, can be coated or lined with insulations of any kind or thickness.

Iron pipe coated with rubber and other compounds has been in more or less general use for gas and water services for many years. These tubes were coated principally for the purpose of preventing oxidation. The present practice in the case of gas and water mains, whether large or small, including all cast iron pipe used in plumbing, is to immerse the same in a hot bath of bituminous material, for the purpose of preventing escape of gases and oxidation. Such a coating in interior conduits would produce a smooth surface which may be of value, and at the same time cheap and serviceable. So far as the insulation of interior electric conduits is concerned, however, dependence must be placed in any and every case on the covering of the conductor and not on the lining of the conduit. There need be no restriction as to the kind of material from which interior conduits are made, provided they conform to the requirements of perfect protection against mechanical and chemical injury to the conductors. Such protection was urged in 1890 by the National Electric Light Association at the Montreal meeting, and has since been insisted on by the National Board of Fire Underwriters, and still more recently at the conference on the amending of the national code of rules for safe wiring of buildings, held at headquarters of the American Institute of Electrical Engineers in New York, March 20, 1896. At this conference the consensus of opinion which had been emphaticallly expressed by several delegates of large experience was tersely summed up by one of the members in the following brief sentences: "The reason for a lining in the interior of iron pipe must be either mechanical or electrical; if it is simply mechanical, it is inexpensive. If the reason is electrical, is it not rather anomalous that, in a city like this, you can have 100 miles of pipe in the street in which the insulated wires lie in a bare grounded tube, whereas the moment you go into a house you must not have it." These requirements need only intelligent interpretation and enforcement to secure satisfactory results. As there is no outward pressure on conduits for electric uses, the same can be made in a simpler and less costly manner than the metal tubes now marketed, and yet possess all the requisite injury-resisting qualities. As soon as this fact is appreciated by manufacturers, evolution will produce the same beneficial results in respect to lessening the cost of material, as was the case with wrought-iron pipe, which has been tremendously cheapened within the past few years through the use of improved methods. The adaptability of material to a purpose is well illustrated in the use of iron pipe in the pipe lines from the oil regions to the seaboard, a distance of over 500 miles. These have been in use for many years under enormous pressures and give perfect satisfaction. On the other hand, all the resources of the United States Government could not provide a masonry conduit that would answer the purposes or stand the tests to which the above mentioned iron-pipe lines are daily subjected.

Professor Silvanus P. Thompson, in his concise and forcible statement made before the Society of Arts, on May 5, 1893, with reference to house wiring, said: "What is wanted is a mode of running the wires and fixing the switches and other accessories, that they shall not only be electric-tight, but shall be water-tight, gas-tight, air-tight, oil-tight, and rat-tight." All of the above requirements, and more, are fulfilled by a properly insulated conductor inclosed in an injury-resisting metal pipe.

In one of the recent installations of one of the large buildings on Broadway, New York, the electrical engineer who made the plans, firmly believing in plain iron pipe, called for it in the specifications submitted to the contractors. The argument used in introducing insulated iron tube, which was afterward installed, was that the insulation did no harm. If this insulation did not cost more than an iron pipe, or a coated iron pipe, that argument might be proper; but the fact is that architects and contractors find it difficult to have their clients agree to

this additional expense. If it is not essential, it obviously suggests extravagance in engineering that is not warranted.

It has been said by an eminent engineer: "Proper engineering consists in utilizing no more material than is required to give satisfactory results." Any additional cost may benefit to a large extent those who seek to market their goods at the expense of a business which would have a more rapid growth if unnecessary cost could be avoided. We are all interested in the promotion of what is at once the cheapest and the best.

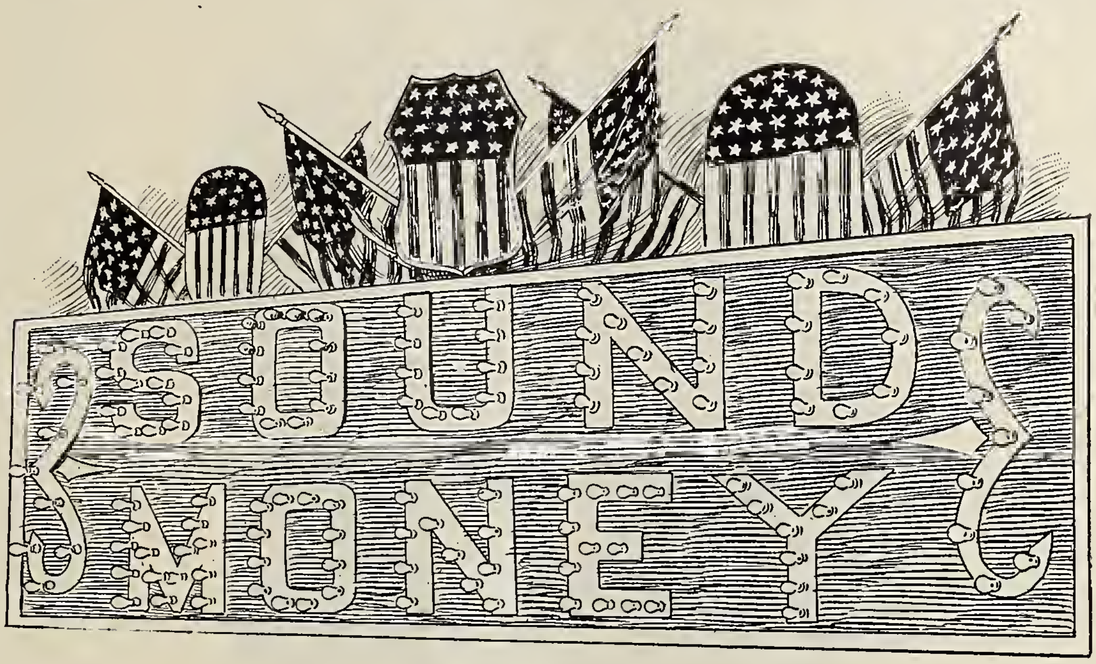
Compound vs. Simple Non-Condensing Engines.—There is said to be a feeling among many engineers, who have had in their plants non-condensing compound engines, that the advantage coming from them is very small, if any at all. Where an engine of this type is run continuously at a steady load, nearly the maximum amount, the steam consumption is somewhat less than the simple non-condensing engine. But with a load at all variable, such appears not to be the case in the long run. For considerable periods of the time the low pressure is doing almost no work and under these conditions the engine is underloaded and not productive of much economy.

Albany, N. Y.—Cobleskill Telephone Company has filed articles of incorporation to construct and operate a telephone line in Cobleskill and from that village to Lawyersville, Schoharie County. Capital, $6,000. Directors, DeWitt C. Dow, Minard Harder, Lester A. Hodge, John H. Tator, Archie C. Kilmer, William W. Simmons and Charles H. Holmes of Cobleskill.

ZIMDARS & HUNT.

Messrs. Zimdars & Hunt, electrical contractors, of No. 127 Fifth Avenue, N. Y., are deserving of much credit for the excellent manner in which they showed their patriotic spirit Saturday, October 31, during the sound money parade.

As evening drew near, paraders passing the office of Zimdars & Hunt were driven to fits of the wildest enthusiasm by a large and brilliant sign containing the words "Sound Money," which the above gentlemen had erected on their premises. For blocks away the colored lamps could be seen, and their brilliancy did not fail to act as a spur to the battalions marching past. On Friday evening the idea was under consideration, and the following day took body and shape.

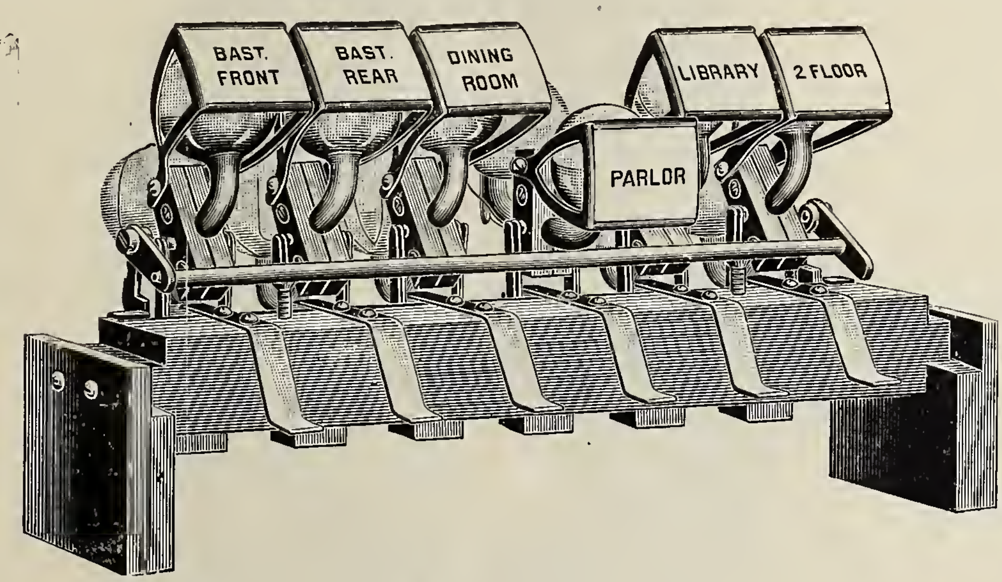


Zimdars & Hunt Sign.

The firm showed their customary quickness and dispatch in getting it out on time. It was built on a wooden framework; the wires were strung, sockets connected, and the sign ready for use in less than a day.

This firm kept open house to all their friends and neighbors. Among them were Hatzel & Buehler, electrical contractors, from No. 114 Fifth Avenue, and a number of representatives from the Edison Illuminating Company.

Zimdars & Hunt have been remodelling their show rooms to get more light and additional conveniences. The windows will be attractive in that they will contain models of exhibition lighting, motor plants, etc.



Battery Protectors.

THE ELECTRICAL AGE has always met with appreciation.

EDWARDS & CO.

An exceedingly ingenious device manufactured by Edwards & Co., 144th Street and Fourth Avenue, N. Y., is their battery protectors.

Each section is governed by two glass bulbs, joined by a tube, partially filled by volatile fluid. In one of the bulbs is a platinum wire.

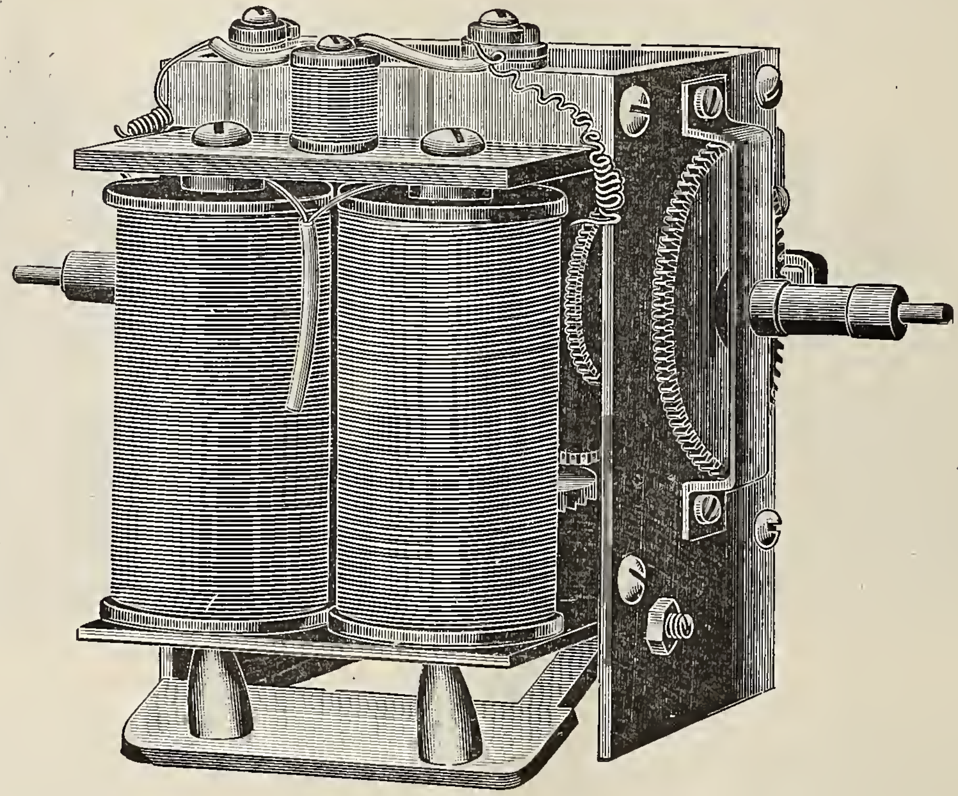
When the circuit is closed the platinum loop is heated, causing the fluid to flow into the other bulb. If the circuit is kept closed any length of time it will cause the fluid to flow into the upper bulb, and as they are pivoted centrally, this bulb will drop, and thus break the circuit on that seetion without interfering with the rest of the house.

After the cause of the trouble is removed the bulbs are reset by raising a switch on side of case.

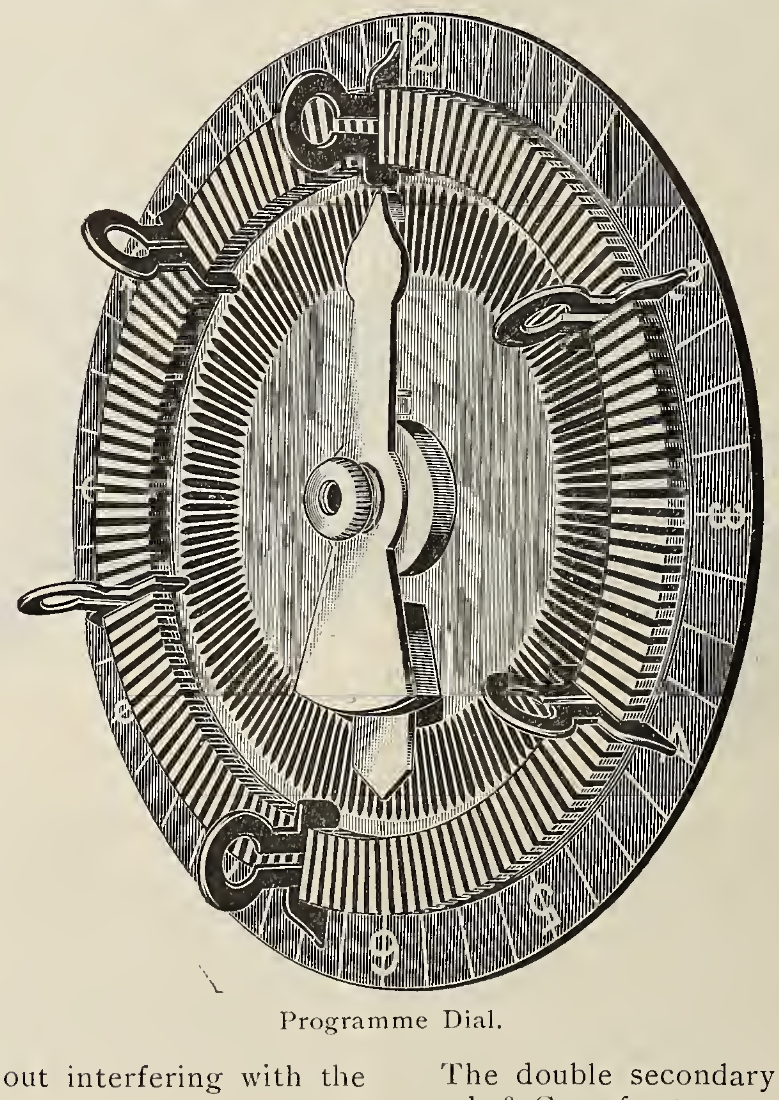
The Electric programme clock, used for colleges, schools, factories, etc., will ring bells at any number of places as often as required.

For schools it will automatically ring bells for assembly, commence, change, or close of exercises, recess or dismissal, etc., and in case of fire all the bells are started and kept ringing; or it may be used as a signal for fire drill, to train the scholars to assemble in order and be dismissed in safety.

The programme dial used in their programme clock is furnished with any number of keys. The hand rotates the same as the hour hand of a clock, making contact on the keys for ten seconds. Any number of bells may be rung by each contact.



Secondary Electric Clock Movement.



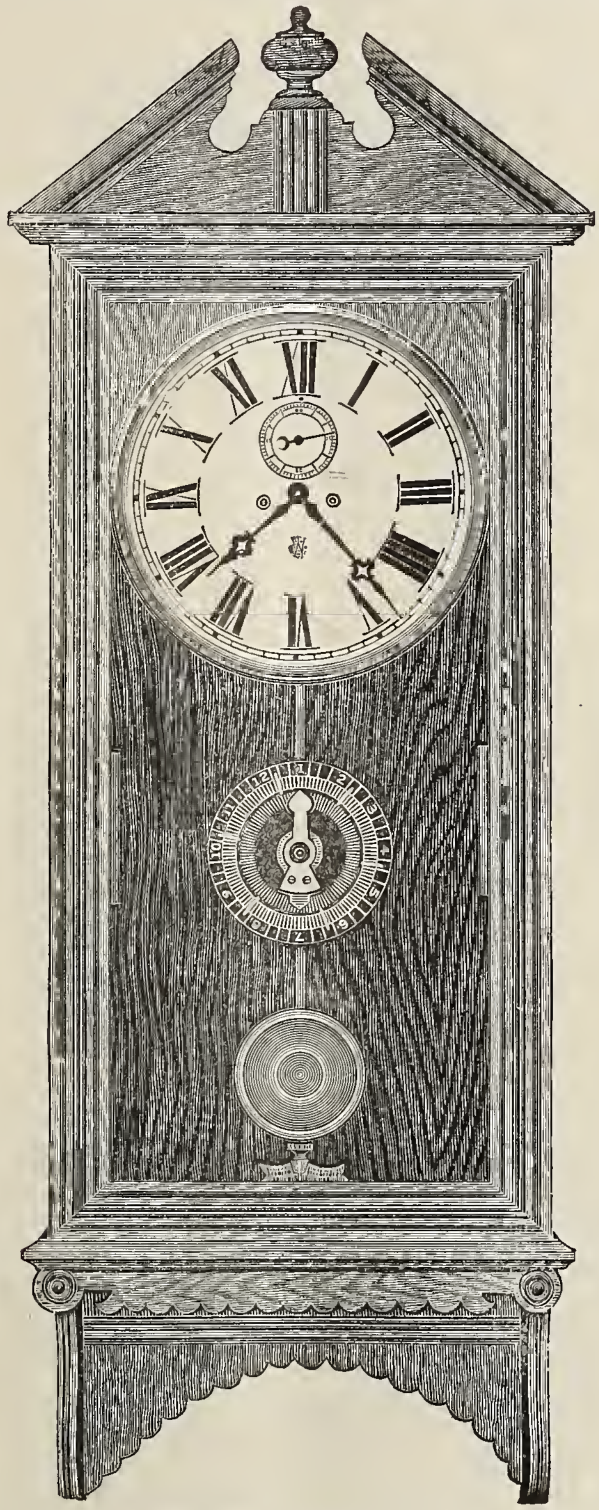
Programme Dial.

The double secondary clock movements sold by Edwards & Co.., for two or more dials, are very simple and complete. It is made for street or tower clocks where large dials are required. It may operate two, three or four.

Electric Greeneries.—Mr. Flemming says that the effect on flowers in the greenhouse raised under the influence of the electric light is very curious. At first the light proved injurious to many blossoms. The color of tulips was deeper and richer for a few days, but they lost their brilliancy when exposed to sunlight. The color of scarlet flowers turned to grayish white, and while all bloomed earlier and produced larger blossoms they soon faded. By reducing the intensity of light and covering them with opal glass globes, the injury to their quality was lessened.

These flowers are double the ordinary size and exceedingly brilliant when kept in dark rooms during the daytime and used only for evening decoration. Mr. Flemming hopes by another winter to ship specimens of these flowers to New York, exposing them for sale only at night in stores lighted by electricity. They are to be used for bouquets or corsage bouquets at night.

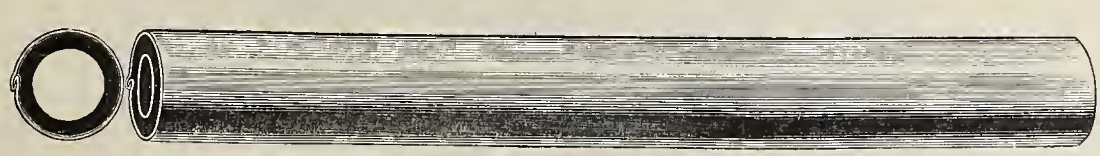
The explanation of the increased growth of plants under the influence of electricity was thought to be the extension of the working season for them—the continuous light preventing them from resting at night, but it is now generally conceded by scientists that electricity helps the plants to assimilate the nitrogen of the atmosphere and favors them in taking up certain mineral salts of the earth—Electrical Doings.



Electric Programme Clock.

Brass Armored Insulating Conduit.—As will be seen in our columns elsewhere, the Interior Conduit and Insulation Co., of New York City, announce a reduction in the prices of their well-known brass-armored insulating conduit, elbows and couplings. The enormous sales of this material during the past year have reduced the cost of production; hence the reduction in price.

This company will shortly place upon the market a new and improved iron-armored conduit, full particulars of which will soon be given.

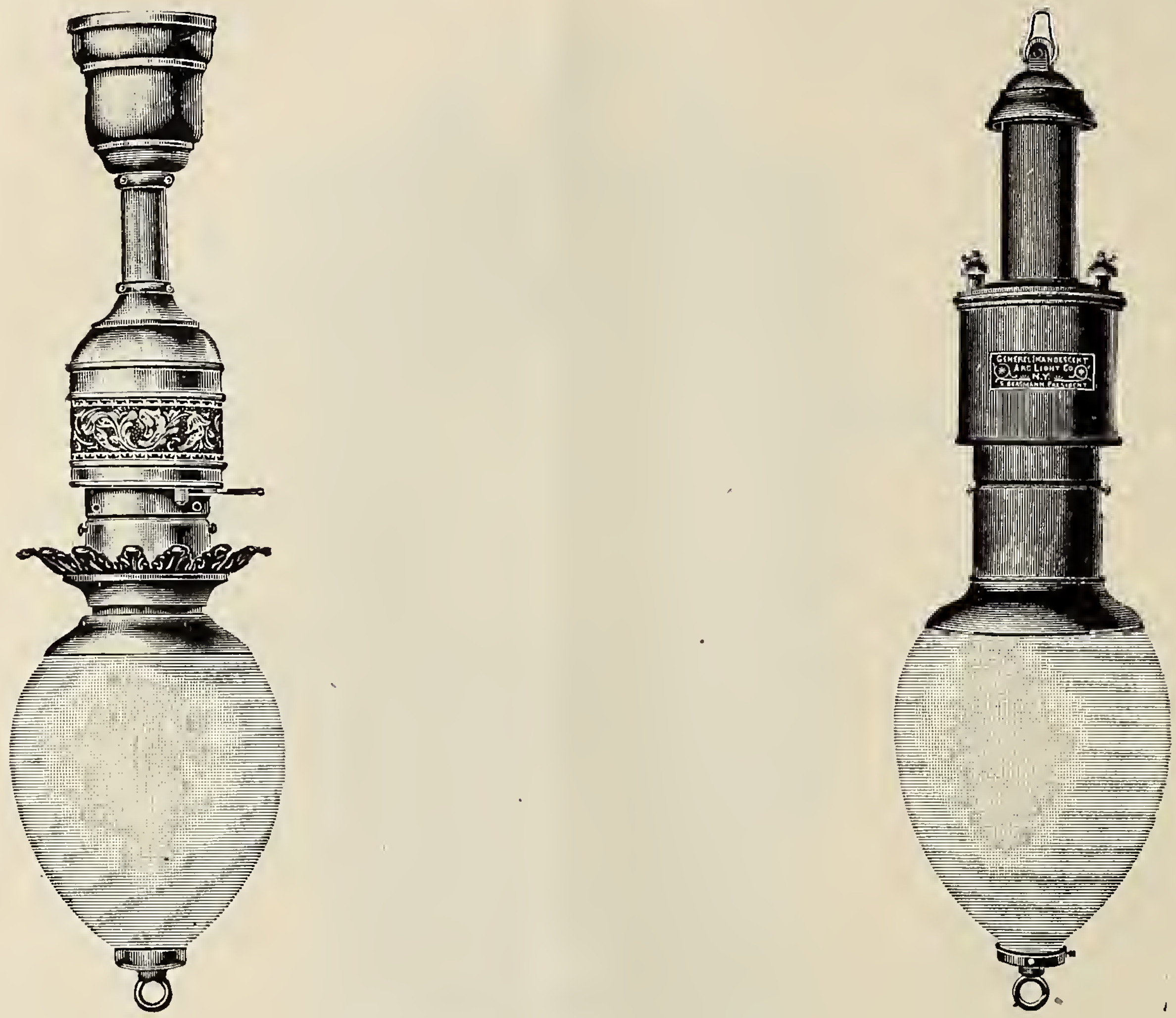


Brass Armored Insulating Compound.

The Economy of High Pressures.—The practicability of running steamships between England and America at the enormous speed which has now been attained is chiefly explained by the saving in fuel due to high steam-pressure. The engines of the "Campania" today develop 30,000 horse-power on the same amount of fuel required by the engines of the "Great Eastern" forty years ago to develop 8,000 horse-power.—Textile Journal.

BERGMANN LONG-LIFE ARC LAMPS.

The Bergmann Long-Life Arc Lamp, made by the General Incandescent Arc Light Co., 572-578 First Avenue, N. Y., burn with an arc of about 80 volts. One set of carbons in these lamps will last 150 hours of burning, saving in both the cost of carbons and labor of trimming. The feeding mechanism is simple and reliable, no springs or gear wheels being used. The regulation is close and the adjustment cannot change. The trimming can be accomplished with great ease, every single part being separably removable. The length of these lamps is 41 inches, and they take a current of from 5 to 6 amperes. The standard amperage is 5. The proper size of carbons is ½ in. x 12 ins. solid upper, and ½ in. x 5½ ins. solid lower. In retrimming, the remainder of the upper carbon is used as a lower.

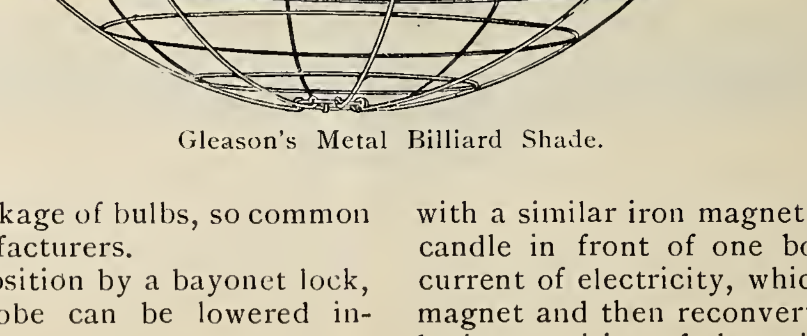


Bergmann Enclosed Arc Lamps.

They are simple, well built and handsome in appearance. The inside globe is attached by a patented device which eliminates the breakage of bulbs, so common in long-life lamps of other manufacturers.

The outer globe is held in position by a bayonet lock, secured positively, and the globe can be lowered instantly.

Seeing Long Distances by the Aid of Electricity.—Dr. Frank M. Close, of Oakland, Cal., has given his name to a new application of Roentgen "X" rays for seeing long distances by the aid of electricity. The apparatus at present is very crude, but it has produced some very remarkable results in light transmission. His device is described as resembling two cigar boxes connected by ten feet of wire. These boxes he calls, as in the telephone system, the transmitter and receiver. In front of the receiver a piece of Iceland spar, or tourmaline, is placed, and the eye is placed on this. In front of the transmitter opening is placed a lighted candle, the flame of which is distinctly seen at the receiver, and, although ten feet distant, and in an adjoining room, if the tourmaline is removed from the receiver the flame is not seen. The object of Dr. Close's investigatinn is to transmit light electrically, after the manner of sound by the telephone. He describes his invention as being simply a soft iron magnet enclosed in a box connected by ten feet of wire with a similar iron magnet at the other end. The lighted candle in front of one box—the transmitter—excites a current of electricity, which is transmitted to the other magnet and then reconverted into the original form, and by interposition of the prism, light is produced. While

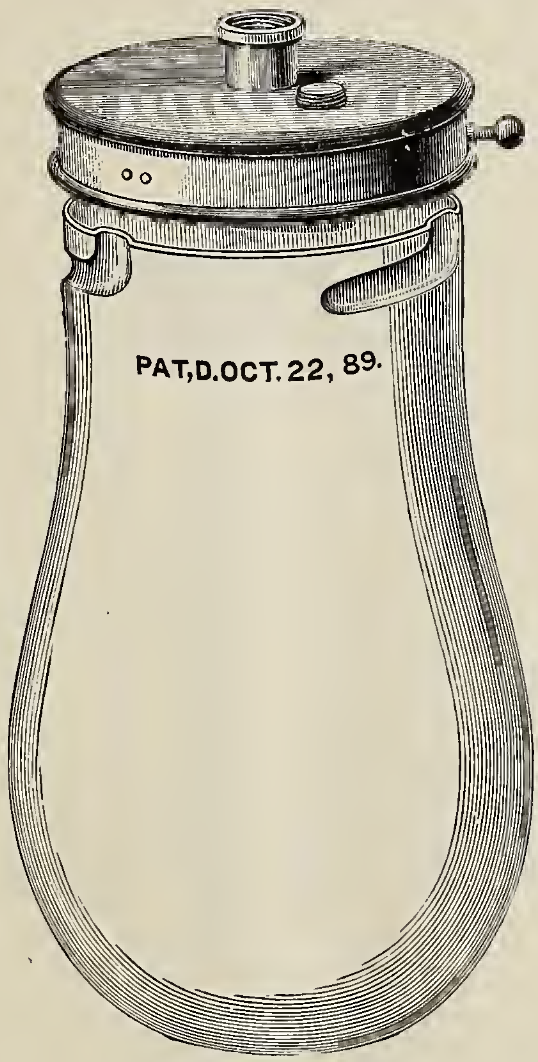


Gleason's Metal Billiard Shade.

n the present apparatus only ten feet of wire is used, Dr. Close believes the effect would be the same with ten miles of wire, and he is very confident that development of his discovery will enable us to see great distances as readily as we now converse over thousands of miles of copper conductors.—Textile Journal.

E. P. GLEASON MFG. CO.

The E. P. Gleason Manufacturing Co., 181-189 Mercer street, N. Y., have placed upon the market some decidedly useful and inexpensive novelties in the line of lamp shades.

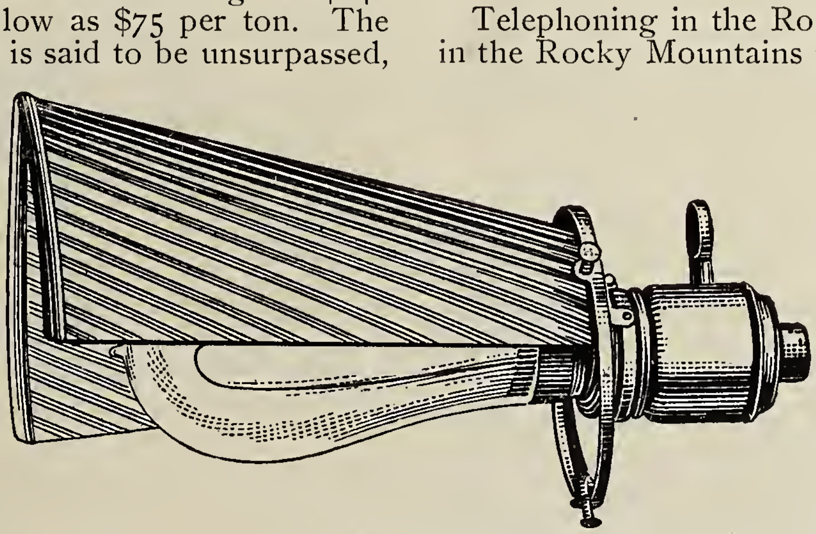


Gleason's Vapor-Proof Globe.

Manganese Ore from Nova Scotia—Consul Young, of Windsor, N. S., reports that the Tenny Cape manganese mines, situated at Tenny Cape, Hants County, N. S., about one mile from good shipping, produce manganese ore of the best quality, and the quantity seems inexhaustible. The ore is noted for its crystals, and is specially suited for use in the manufacture of glass. The mines have been worked to a limited extent, with but little intermission, for about thirty years. About two years ago a new company was formed with a large capital, for the purpose of mining and selling the ore. Heretofore, not more than 75 tons was the average output, but with improved appliances a much larger output is expected. At one time this ore sold in New York as high as $140 per net ton, and has sold as low as $75 per ton. The quality of the Tenny Cape ore is said to be unsurpassed, and therefore it is sought for by dealers who require manganese of a high grade.—American Manufacturer.

Nanaims, B. C.—The city council have decided to expend $3,000 for a new electric fire-alarm system.

Some samples of the same are illustrated in these pages. A metal billiard shade with hinged brass wire guard. A metal foot-light screen with holder attachment, to fit any socket. A corrugated side shade, bright inside, green outside; excellent for blackbroad or picture lighting. A weather-proof globe for incandescent lights of two designs; one merely screwed tight on top with cover; the other, a *vapor-proof* globe provided with a vent, which relieves any pressure developed when the air is expanded by the heat from the lamp. The excellence of all innovations produced by the Gleason Co. have given them a hearty welcome in every case.


Gleason's Corrugated Side Shade.

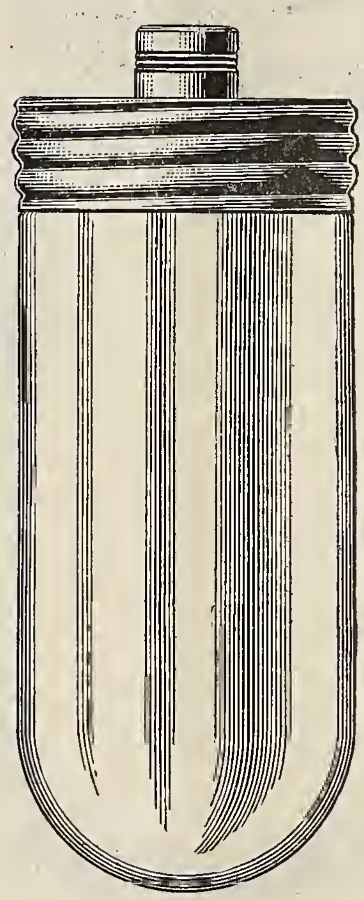
Telephoning in the Rockies.—Telephone construction in the Rocky Mountains is attended with a great deal of hardship. The line built from Leadville to Aspen several years ago is a case in point. It took two months to cover the entire length, forty-eight miles. In ordinary construction, the poles would be set 42 to the mile, but

at certain points, where sharp turns were necessary, the number is sometimes increased to 75 to the mile. The members of the construction gang had to be as expert as axemen as they were as linemen, for when timber was encountered a path of 200 feet on each side of the line had to be cleared in order that wires might not be broken when trees were blown over by the terrific blasts which at times prevail in that region.

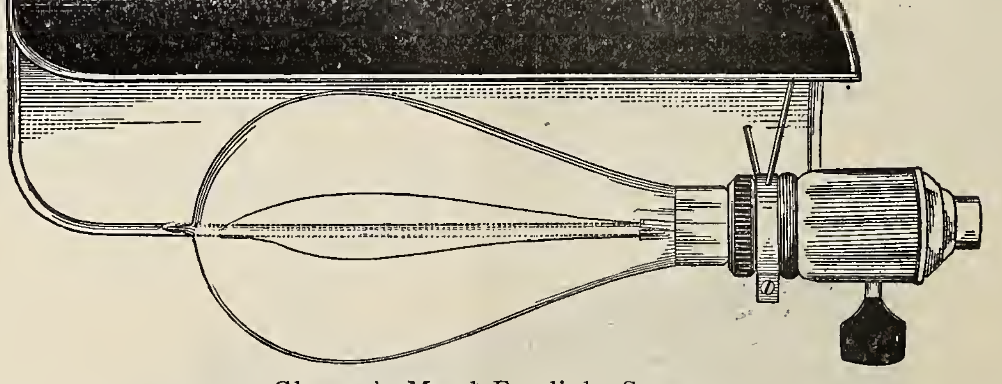
A great deal of the comparative slowness of the installation was owing to the inability of the workmen to labor in such a rarefied atmosphere. At one point the wires were strung at an elevation of 12,000 feet above the level of the sea. In such an altitude the lineman soon becomes completely tired; after he has climbed two or three poles he has to take a rest to recuperate his energies. The preparations of the holes for poles, which would have been tedious in similar ground even in an ordinary atmosphere, was an especially slow and fatiguing operation. It was often necessary to blast a hole for the pole by the use of giant powder, and an ex-miner, who had an extensive experience with explosives, was assigned to the job.

The digging of one pole hole would sometimes occupy him a whole day, working honestly. Over 300 pounds of powder were used on the line for this purpose. When the continental divide was reached, the poles had to be abandoned and the wires placed in a cable, which was buried in a two-foot trench for a distance of 7,600 feet. The advisability of abandoning aerial construction at this point was demonstrated by the experience of the company that maintains the Denver and Leadville line. At one point on that line, Mosquito Pass, the poles were originally set 707 feet apart. As soon as the wires were covered with sleet they snapped and the line was useless. Double the number of poles was then used, with the same result. The space between the poles was then reduced to 25 feet, but when the sleet came the line was swept down flat. Eventually an underground cable was laid for two and a half miles, and there has been no trouble since.—From "Field and Farm."

Deseronto, Can., is partially lighted by gas obtained from the sawdust of the lumber mills. The sawdust is charged in retorts which are heated by a wood fire. The gas from these retorts passes into a series of coils and thence into the purifiers, which are similar to those used for coal gas. Lime is used as a purifying agent. The plant is not a very large one and it only turns out 540 cubic meters of gas per day, for which about two tons of sawdust are required. A man and boy furnish all the labor needed at the works. The best quality of gas comes from resinous woods. One hundred kilogrammes of sawdust leave a residue of twenty kilogrammes of charcoal, and the gas in an ordinary burner, says the "Engineering and Mining Journal," gives an illumination of about eighteen candle-power.



Gleason Weatherproof Globe.



Gleason's Metal Footlight Screen.

AMERICAN ENGINE COMPANY.

The American Engine Company, of Bound Brook, N. J., have begun the shipment of their new engines known to the trade as American Ball Engines. The first of these engines, of 100-H. P. capacity, has gone to the Detroit Evening News, and the second, a 50-H. P. engine, to the Savannah News. Since the addition of this new

line of work the business of the American Engine Company has increased, so that they are now compelled to redouble time, having installed a night force. In the electrical department among the recent shipments are the following: Cliff Paper Co., Niagara Falls, N. Y., two motors, 150 H.-P. each; Detroit Evening News, Detroit, Mich., two dynamos, each 25-K. W.; Albany Morning Express, Albany, N. Y., one 18-K. W. dynamo; Oakland Tribune, Oakland, Cal., 25-H. P. motor; A. N. Kellogg Newspaper Co., Chicago, Ill., four 15-H. P. and one 25-H. P. motor; Topeka Capital, Topeka, Kan.. 5-H. P. motor; Boston Traveler, 12-H. P. and 5-H. P. motors; Worcester Post, Worcester, Mass., 9-K. W. dynamo; Cincinnati Post, Cincinnati, O., 35-H. P. motor; Philadelphia News, 25-H. P. and one 3-H. P. motor; Elmira Gazette, 25-H. P. motor; American Newspaper Publishing Co., 25-H. P. motor; Carrington Publishing Co., 12-H. P. motor; J. B. Cranfill, Waco, Tex., 25-H. P. motor; Fall River Publishing Co., Fall River, Mass., one 25-H. P. and 3-H. P. motor; Saginaw Evening News, Saginaw, Mich., 12-H. P. motor; B. A. Meade Co., Augusta, Me., 3-H. P. motor; Grand Rapids Democrat, 15-H. P. and 3-H. P. motor; St. Paul Pioneer Press, St. Paul, Minn., 5-H. P. motor; Wallace Publishing Co., Des Moines, Iowa, 12-H. P. motor; New York Tribune, two 15-H. P. motors; Chicago Journal, 15-H. P. motor; Rubber Tire Wheel Co., N. Y., 12-H. P. motor.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
*Edison Elec. Illg. Co., New York,	92	95
*Edison Elec. Illg. Co., Brooklyn,	93¾	95
Edison Ore Milling Co.,	7¾	10
Edison Elec. Storage Company,	27¾	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co. T. Sec. Series A,	2½	4
General Electric Company,	29½	30¼
General Electric Company pf.,	63	65
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	80	81½
Rhode Island Elec. Protec. Co.,	—	122
Royal Elec. Co. (Canada),	105	115
Toronto (Canada) Elec. Light Co.,	—	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	98	105
Westinghouse Elec. & Mfg. Co.,	24	26
Westinghouse El. & Mfg. Co., assd.,	49	50
Westinghouse El. & Mfg. Co., assd.,	49	—

*Ex dividend.

Many large orders for Lundell motors have been closed lately with the Interior Conduit and Insulation Co., No. 527 W. 34th street. The American Lithograph Co. bought 134 motors to be direct-connected to the presses. The American Bank Note Co. received nine motors recently; these orders representing a small fraction of those that have been pouring in of late.

Sussex, N. B.—The Sussex Water and Electric Light Company has been organized here.

CANADIAN LETTER.

Montreal, Que.—Messrs. Hogg and Morgan, of this city, are busily engaged attending to expropriations at Longue Pointe, connected with the construction of the Chateauguay and Northern Railroad. The arbitrators are Messrs. Brodie for the company; J. P. B. Casgrain for the propriators and Mr. Louis Allard as third arbitrator.

Huntsville, Ont.—Tenders are being received by Wm. Rumsey, village clerk, for the construction of a system of water-works and electric light as follows: Power station, pumping machinery, boiler, valves and hydrants, dynamo, engine, switchboard, wiring, etc. Plans and specifications can be seen at the court house.

Granby, Que.—The installation of an electric light plant is being agitated.

Orillia, Ont.—G. E. Grant, town clerk, is receiving tenders for an electric fire-alarm system consisting of seven alarm boxes and automatic striker.

Parrsboro, N. S.—Dr. J. R. Smith has secured from the town a franchise to operate an electric light plant.

Oshawa, Ont.—Tenders are being received by the corporation for lighting the town by electricity for a term of three years, from 1st of November next.

Ottawa, Ont.—Among the estimates presented to the Dominion Government, the following appropriation has been decided: the sum of $1,000 is provided for the purpose of remodelling the present electric lighting in the Dominion building at Halifax, N. S.

Dundalk, Ont.—The town authorities are now discussing the advisability of lighting their town by electricity.

St. John, N. S.—The city is replacing the arc street lights with incandescent lamps at a considerable saving.

Quebec, Que.—The Quebec, Montmorency and Charlevoix Railway Company has transferred its rights on the Electric Railway to the new company. Two hundred men will be put on the lower town section to St. Sauveur next week. The rails are expected from Chicago this week. In connection with the construction of the electric railway, it is probable that a bridge will be built over the St. Charles River to Parent Park.

Aylmer, Que.—The Hull Electric Railway has bought ground for a new park just outside of Aylmer.

Brantford, Ont.—The power-house of the Brantford Electric and Operating Company is being constructed rapidly. The company is spending over $30,000 in improvements.

Paris, Ont.—It is probable that an electric railway will be built from this place to Brantford.

Hamilton, Ont.—The Hamilton Radial Railway Company intends to extend its line from the power house to Port Nelson, and next spring it will be extended to Oakville.

Liverpool, N. S.—An electric railway is to be built at once from this place to the pulp mill at Milton, to carry its products as well as passengers to the seaport. In the meantime, until a suitable electric plant can be obtained, the cars will be run by steam.

Niagara Falls, Ont.—The Niagara Falls Park and River Electric Railway will, it is said, be extended from Chippewa to Fort Erie and from Queenstown to Niagara-on-the-Lake. The company may also develop and sell power. It is thought that road, if operated more nearly in connection with the George Railway on the United States shore, would be a profitable investment for its shareholders, which it has not hitherto been.

J. Alcide Chausse.

Henry Roessle, No. 22 Spruce Street, N. Y., makes a specialty of metal spinning, either from designs furnished or original ideas supplied by himself.

Brass, copper and other metals spun to any shape. He engages in the manufacture of railway supplies and novelties. Mr. Roessle is one of the finest artisans of his line in the country.

Take the magnificent North Shore Limited of the New York Central for Chicago and the West.

Mexico, November 1, 1896.

Mr. George C. Sperry is this date appointed superintendent of telegraph with headquarters at the City of Mexico.

Mr. Sperry will have direct charge of all matters pertaining to that department except revenue, which will remain with the traffic department as heretofore.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued September 22, 1896.

Copies of any patent will be forwarded on receipt of 10 cents each.

567,966. Substance for Telephone Electrodes. Daniel Drawbaugh, Eberly's Mill, Pa. Filed January 10, 1896.

567,975. Trolley and Trolley Support for Electric Cars. William Grunow, Jr., Bridgeport, Conn. Filed September 23, 1895.

567,976. Electrically Heated Smoothing Surface. William S. Hadaway, Jr., New York, N. Y. Filed March 24, 1896.

567,982. Automatic Device for Electric Current Regulation. Ernst W. G. C. Hoffmann, Charlottenburg, Germany. Filed April 17, 1896. Patented in Germany, February 28, 1891.

567,984. Electric Signaling Device. George F. Knollmann, Evansville, Ind. Filed August 7, 1896.

567,989. Electric Brake. Alexander F. Macdonald, Schenectady, N. Y. Filed April 18, 1896.

567,994. Paper Feeding Machine. Robert S. Oder, Kansas City, Mo. Filed November 26, 1892.

567,995. Paper Feeding Machine. Robert S. Oder, Kansas City, Mo. Filed July 12, 1895.

568,007. Electric Battery. Henry C. Thomson, Boston, Mass. Filed June 25, 1896.

568,013. Multiple Circuit Closer for Electric Trappulling Devices. Thomas R. Barney, San Francisco, Cal. Filed April 21, 1896.

568,060. Insulator. William Wood, Middlebury, Conn. Filed March 11, 1896.

568,088. Apparatus for Controlling Electric Motors. Harry W. Leonard, East Orange, N. J. Filed April 30, 1896.

568,099. Electrolytic Apparatus for Extracting Gold and Silver from Their Ores. Louis Pelatan, Paris, France, and Fabrizio Clerici, Milan, Italy. Filed October 1, 1895.

568,103. Telegraph Instrument. Otto M. Runkle, Columbus, Ohio. Filed June 2, 1896.

568,142. Apparatus for Manufacturing Incandescent Electric Lamps. George R. Lean and John R. Massey, Cleveland, Ohio. Filed December 21, 1895.

568,168. Electric Car Heater. Joseph G. Noyes, Milford, Conn. Filed April 8, 1896.

568,176. Apparatus for Producing Electric Currents of High Frequency and Potential. Nikola Tesla, New York, N. Y. Filed April 22, 1896.

568,177. Apparatus for Producing Ozone. Nikola Tesla, New York, N. Y. Filed June 17, 1896.

568,178. Method of Regulating Apparatus for Producing Currents of High Frequency. Nikola Tesla, New York, N. Y. Filed June 20, 1896.

568,179. Method of and Apparatus for Producing Currents of High Frequency. Nikola Tesla, New York, N. Y. Filed July 6, 1896.

568,180. Apparatus for Producing Electrical Currents of High Frequency. Nikola Tesla, New York, N. Y. Filed July 9, 1896.

568,193. Apparatus for Generating Electricity for Lighting or Heating Railroad Cars. Charles E. Dressler, New York, N. Y. Filed May 2, 1894.

568,204. Electric Sign. Mortimer Norden, New York, N. Y. Filed February 28, 1896.

568,209. Electric Lamp for Velocipedes, etc. Alfred M. Rodriguez, Brooklyn, N. Y. Filed December 20, 1894.

568,223. Combined Globe Holder and Ash Pan. Thomas E. Adams, Cleveland, Ohio. Filed April 6, 1895.

568,229. Electrode. Henry Blackman, New York, N. Y. Filed February 9, 1895.

568,230. Electrode for Electrolytic Decomposition. Henry Blackman, New York, N. Y. Filed May 9, 1895.

568,231. Electrolytic Anode and Apparatus. Henry Blackman, New York, N. Y. Filed May 21, 1895.

568,262. Incandescent Lamp. John T. Lister, Cleveland, Ohio. Filed April 25, 1896.

568,298. Method of Making Underground Conductors. John H. Croskey and Joseph Locke, Pittsburg, Pa. Filed May 21, 1896.

The Electrical Age.

VOL. XVIII., No. 20. NEW YORK, NOVEMBER 14, 1896. WHOLE No. 496

Switchboard of Storage Battery Plant.

STORAGE BATTERIES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The subject of storage batteries is of as much commercial as scientific interest. Not only have millions of dollars been spent in their introduction, but a like sum has found its way to the laboratory, in which many have sought to improve it to a point of commercial excellency.

What a storage battery is.—The storage battery, or, as it was called in earlier days, the Planté or Faure cell, is not a cell in which, strictly speaking, electricity is stored; but it is a means by which electicity causes certain chemical changes that produce all the phenomena of a primary cell upon discharge.

Electricity is not *stored*, but chemical energy is stored, and therefore the problem of the perfection of the storage battery is almost exclusively a chemical one. Let us review the incidents connected with the development of the storage battery.

Discovery of the principle.—When a pair of platinum electrodes are allowed to dip into acidulated water and small tubes are arranged to collect the gas, they dispel by decomposition, a galvanometer connected in circuit will show a return current when the current from the battery or dynamo is stopped.

The platinum electrodes dipping into the liquid accumulate two gases, respectively oxygen and hydrogen. It seems that these two gases act towards each other as copper and zinc, or the electrodes of any primary battery. The return current observed is therefore due to the gradual recombination of these two gases into water, and the chemical union creates a reverse current which flows through the wires and affects the galvanometer.

Polarization, which is practically the accumulation of a gas or gases that oppose the passage of a current in a primary cell, is therefore the cause of the secondary or return current in a storage battery.

With two platinum plates in dilute sulphuric acid the current of polarization gradually increases up to a pressure of 2.6 volts.

It is therefore a back electrical pressure which opposes the original current, and manifests itself when the first current is discontinued and the second allowed to circulate freely.

Size of plate. — It is very evident that the larger the platinum plate the greater the amount of gas given off and the greater the capacity of the plate for current. The size of the plate, therefore, limits the amount of gas that is given off and the capacity of the cell.

Ritter discovered that any two pieces of metal would accumulate chemical energy by this means, which they would afterward give out in the form of electrical energy. The two pieces of metal become independent sources of current after being disconnected, and act to all intents and purposes like a voltaic cell.

Plante made a series of experiments, the result of which showed that of all the metals experimented upon lead had the greatest capacity for polarizing effects, and therefore made the best form of secondary cell.

The Plante cell is made by taking two lead plates, immersing them in dilute suphuric acid and applying a strong current.

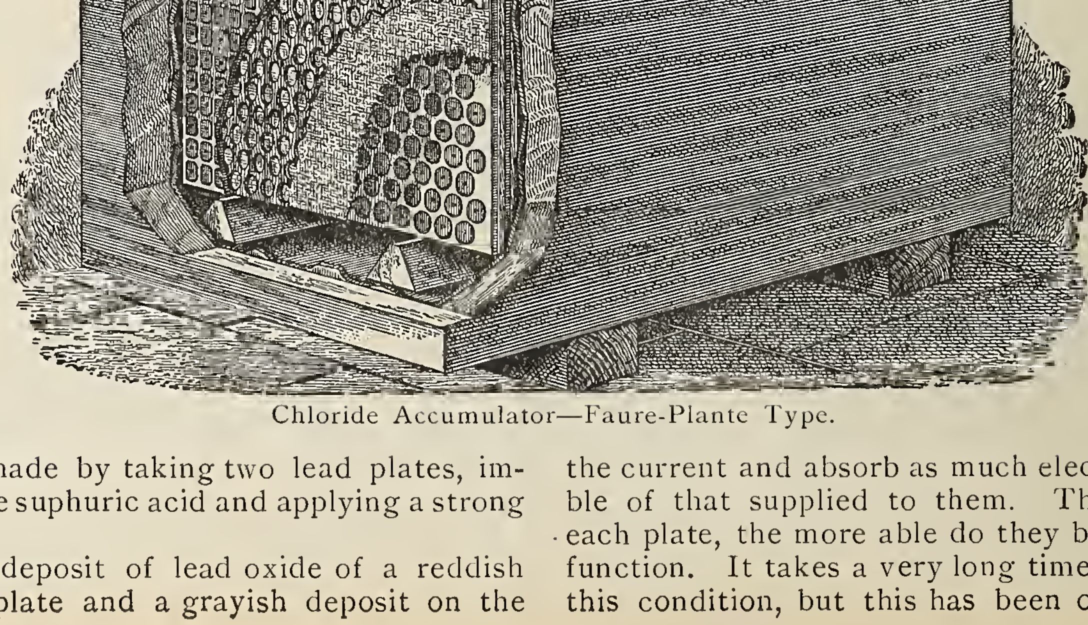
Eventually a thick deposit of lead oxide of a reddish color forms on one plate and a grayish deposit on the other. In the course of time, by continued charging, these deposits become deeper and deeper ; the reddish deposit penetrates to the very core of the plate and transforms it entirely, increasing its capacity for continued discharge and volume of current.


A Pasted Cell—Faure Type.

The positive plate is the reddish plate, upon which has formed an oxide of lead. This deposit is called peroxide of lead and is of a spongy nature. The more spongy it becomes, the better its qualities as a reservoir for chemical energy but the poorer it becomes mechanically, as it disintegrates and eventually becomes difficult to handle.

The negative plate is of grayish color, and likewise becomes an oxide of lead; the positive plate, a higher oxide than the negative. In fact, the negative is covered with a coating of dioxide of lead.

Forming.—It is necessary in order to get the cell into full working operation to have the cell formed, as the expression goes.

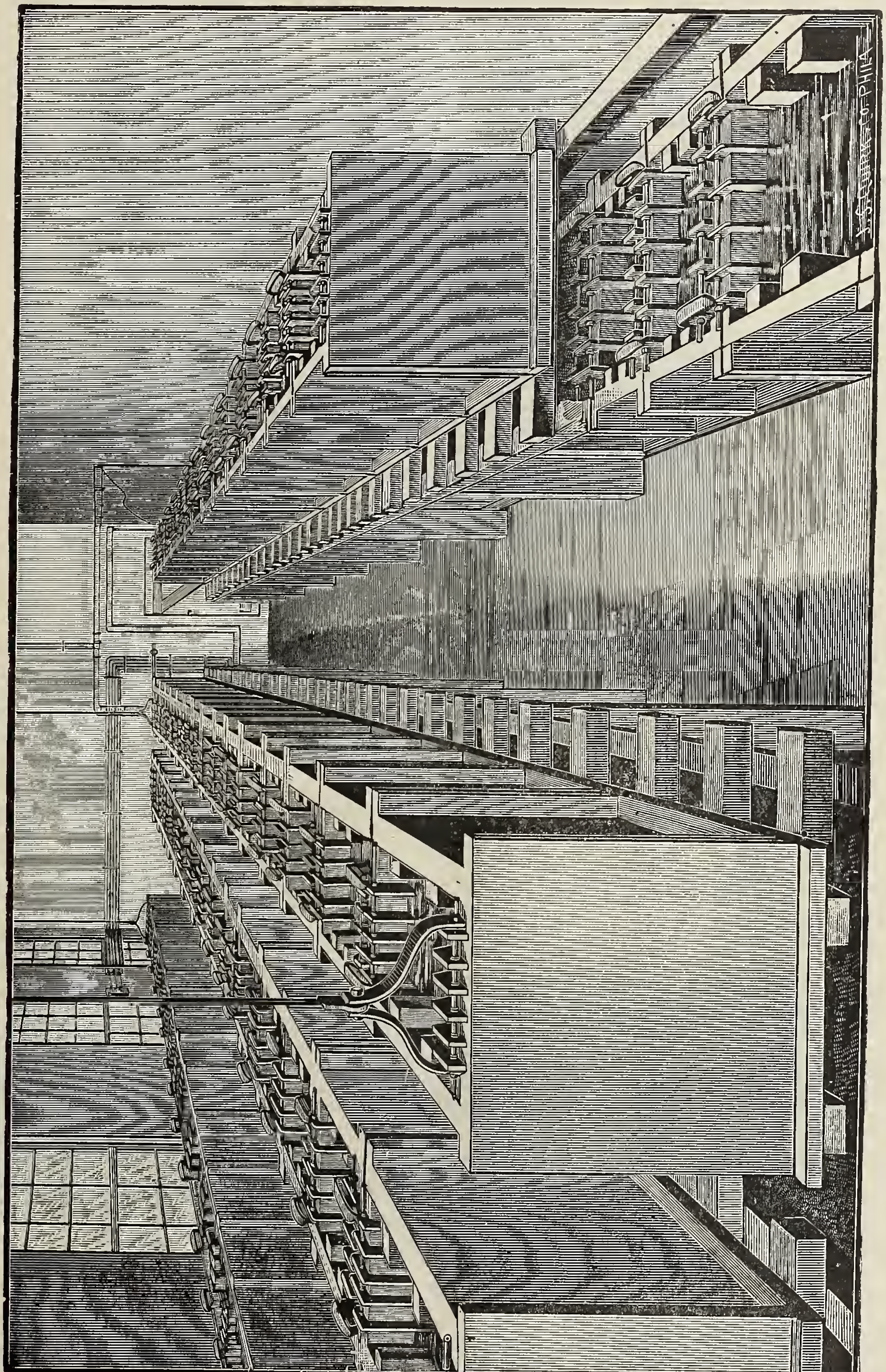

Chloride Accumulator—Faure-Plante Type.

The plates must respond chemically to the influence of the current and absorb as much electrical energy as possible of that supplied to them. The thicker the oxide in each plate, the more able do they become to perform this function. It takes a very long time to get *lead* plates into this condition, but this has been overcome by Faure.

The Faure battery is merely a modification of the Plante cell. Faure very carefully considered the question of forming the plates and concluded to try the effect of oxides applied artificially to them.

It seemed to him that time would be saved and all the long period of forming (which covered an interval of several months) reduced down to a few weeks. By experiment he found his reasoning to be true, and storage batteries became one of the most popular inventions of the age.

Red lead was applied to the positive plate, so called because when being charged the positive current was sent into it, and when discharged, the positive current left it. This was *pasted* to the plate by means of glycerine or some other liquid capable of forming it into a paste.



Charging Station for Storage Batteries.

When the current was applied to this and the negative plate, the red lead changed into peroxide of lead, became spongy and absorbed electrical energy to a great extent.

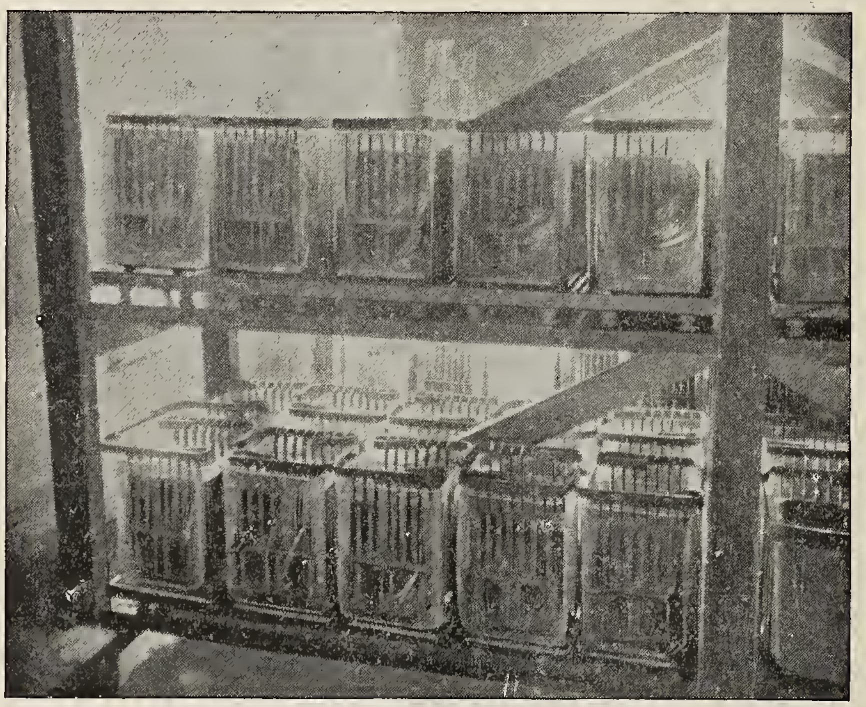
Litharge was applied to the negative plate, or that intended to be such, and, as above, a chemical reduction took place, the applied oxide becoming active as dioxide of lead.

Grids were formed of lead moulded into shape, and the lead oxide was applied to them in the form of paste.

A great patent suit was instituted against infringers by those claiming the exclusive right to apply *paste* to grids. One of those attacked were the Julian Company, who exercised considerable ingenuity by compressing powder into the grids, which was the most effective way to apply the oxide, instead of using *paste*—the main point at issue.

Inoxidizable grids were a valuable addition to the art, because the ordinary plate became *mechanically weak* by oxidation. The use of an alloy of antimony, lead and mercury gave the Julian Company a grid of the greatest value.

The Chloride Accumulator is practically a Plante cell. Pastiles of lead in a very spongy state are formed by pressing together chloride of zinc and lead; afterwards dissolving the zinc and leaving a spongy mass of lead in its place.



Shelf Arrangement of Cells—Private Plant.

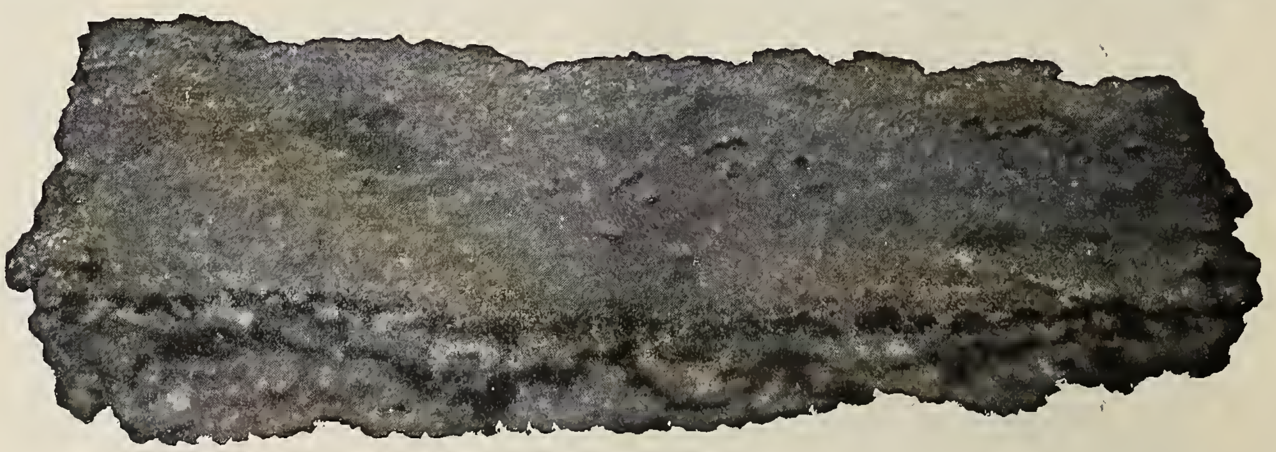
The Chloride Accumulator Co. use a grid with circular holes, in which in their latest form of plate they compress spirals of corrugated lead; this is their positive plate.

The objects to be kept in view in the manufacture of accumulators are, with regard to the plates—

Large surface,
Mechanical strength,
Long life,

by which means a great storage capacity may be obtained as well as commercial success in their introduction.

Buckling, which formerly was caused by the weakness of the plates, is due to a sudden discharge of great



Porous Lead Plate.

volume. The gases occluded by the oxides expand or escape so quickly that the plates become distorted or bent. Plugs are driven out and the battery may be either ruined or temporarily disorganized.

Sulphating is caused by the plates remaining in the acid solution too long uncharged. A thick, whitish coating of sulphate of lead forms which is very difficult to get rid of, except by heavy charging.

The voltage of a cell when fully charged approximates 2.1 volts; it falls during discharge to about 1.9 volts, or less. It is not wise to let them fall below this in pressure as a heavier discharge will be apt to injure them or require a long period of recharging.

Buckling and sulphating are the two great evils—buckling, a mechanical, and sulphating, a chemical one. Either may be obviated by a little care and attention. Overcharging is not decidedly injnrious, but undercharging with a leakage of current may bring on sulphating in time. A battery must be kept charged even when not in use. The plate which wears out quickly is the positive or peroxide plate.

AMBROIN, A NEW INSULATING MATERIAL.

A new insulating material, introduced by H. Gumpel, of Berlin, under the name of Ambroin, which does not appear to be particularly appropriate considering the generally dark color, is described as consisting of fibre, silicates and rosin, highly compressed to a mass which resembles hard rubber more than amber. The color varies between light brown and green and black; it is prepared in different varieties, and can be worked into buttons, boxes, tubes, collector rings, rosettes, etc. It can be cut, turned, bored, soldered, welded, stamped, and would thus appear to be a remarkably docile substance. The electric resistance of one milliard of ohms of which the Gummi Zeitung speaks is not intelligible without further information. That the material would resist atmospheric influences because its raw products are the remainders of centuries of atmospheric attacks is a peculiar argument. Various ambroins can be heated up to 800 and 2,700° Fahr.; sulphuric acid does not attack the stuff at 170° Fahr.; nitric acid causes a slight superficial nitration, acetic acid and even aqua regia are without effect; alkalies, if not concentrated, do not injure the ambroin either. It is satisfactory to hear that the

ambroin with its several varieties is less a rival than a supplement to other materials. At the Berlin Exhibition accumulator boxes, electrolytic vats, etc., of ambroin are to be seen.

STANDARDS OF LIGHT.

(Continued from page 649.)

II.

KEROSENE OIL LAMPS.

These lamps have been quite extensively used as secondary standards, and have been usually found very satisfactory.

The chimney used had a considerable influence on the intensity.

Herr Von Hefner-Alteneck‡ has emphasized the points of excellence of kerosene lamps, claiming that they are superior to the Carcel lamp.

In some of the measurements of the intensity§ of a candle as a function of the height of its flame, a kerosene lamp with an Argand burner, similar to the ordinary student-lamp burner, was used. The upper part of the chimney was covered by a tightly-fitting cylinder of ferrotype iron, in such a way that the top of the flame was entirely hidden. This furnished a very steady source of light, after it had been burned long enough for the parts to become thoroughly warmed, and its intensity was unaffected by slight adjustments of the height of the flame, provided

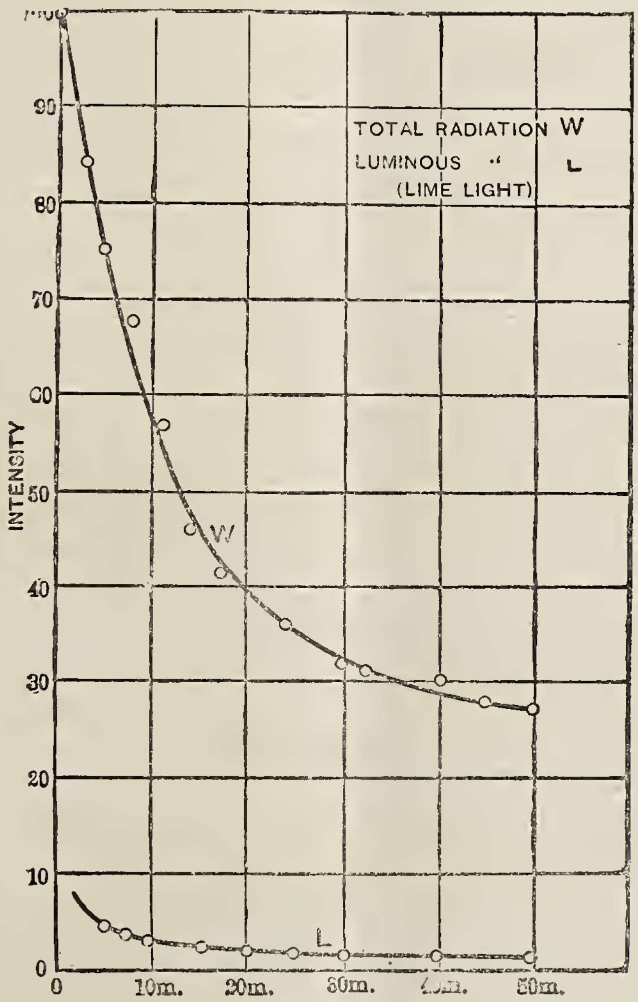


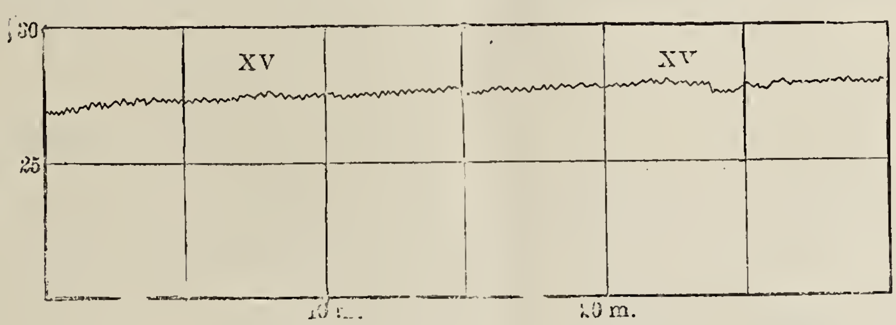
Fig. 18.

Heim,* in studying the efficiency of various sources of light, used a kerosene lamp as a secondary standard, with good results.

A screened kerosene student's lamp has been found to give good results when used in the Edgerton photometer.† The screen was pierced with a round hole 12 mm.

only that the flame was always high enough. Its intensity varied enough from day to day, however, to make its indications unreliable without a daily calibration.

A convenient form of kerosene lamp requiring no chimney, in many ways suited to photometric purposes, is the Hitchcock mechanical draught lamp, made at Watertown.



in diameter. With different kinds of kerosene there was a slight difference in intensity. A series of ten observations, each with flame height varying from 65 mm. to 300 mm., showed a maximum variation in intensity of only five per cent. Changes in flame height amounting to from 12 to 25 mm. made inappreciable differences in intensity.

XIII.

THE CARCEL AND KEATS LAMPS.

The Carcel lamp has been in use for very many years in France, and in the hands of experienced operators it is capable of yielding good results. The combustible is

* Hein, Lumiere Electrique, 26, p. 220.
† Polytechnic Review, 1878, 5, p. 161.

Dingler's Polytechnisches Journal, 229, p. 48.
‡ Von Hefner-Alteneck. Elektrotech., Zeitschrift, 4, p. 445.
§ Sharp. Phys. Rev. Part IV. of this report.

colza oil, the normal rate being 42 grams per hour. The most exhaustive tests of its behavior are those of Audoin and Bérnard,* made under the directions of Dumas and Regnault. In these experiments the effect of the height of the work, its nature and the height of the contraction in the chimney, were studies with reference to the consumption of oil. The results indicate that it it is unjustifiable to take the intensity as proportional to the rate of burniag unless these variables are very carefully looked after, that is to say, unless the lamp is always used under conditions which it is very difficult to maintain constant.

FIG. 17.

In countries other than France, the Carcel lamp has met with little favor, the results of tests showing considerable variations in behavior. Dibdin's results (1888) show a mean deviation from 33 sets of observations of 1.34 per cent., disregarding signs. The maximum was 4.1 per cent., 32 per cent. of the tests being within one per cent. of mean.

The Keats lamp shows a better behavior. Thus Dibdin found 71 per cent. of his observations within one per cent. of the mean and a maximum variation of 3.4 per cent. On the strength of these comparative results he rejects the Carcel lamp in favor of the Keats. His report of 1888 shows, for the Keats lamp, a maximum deviation from mean of 9.4 per cent., 39 per cent. of the observations being within one per cent. of mean. He says: "The Keats lamp has been tried most thoroughly, but has failed in practice to realize all that was formerly hoped for it, not so much from any inherent defect as from the severe trial it makes, as compared with other systems, upon the patience of the observer."

Figure 17 contains a curve which is typical of the behavior of this source of light. It will be noted that the rapid fluctuations, charactistic of naked flames, are almost absent.

The curves obtained in the study of the Carcel lamp all show clearly the great gain in steadiness of the flame resulting from the use of a proper chimney. The deviations were, for the most part, no larger than the swings of the galvanometer when the bolometer was unexposed to radiation. The variations extending over a considerable period of time are, however, by no means inconsequential. In the course of one test there was a total deviation in the mean ordinates of the five-minute periods of 5.1 per cent., taking place in ten minues. Another experiment shows a deviation of less than 0.8 per cent in 35 minutes, and this is perhaps a more typical illustration of what may be expected from this lamp when burned under the best conditions. The highest and lowest points on any of the Carcel curves are 29.9 and 25.4 respectively, corresponding to deviations from the mean of the curves of + 5.7 per cent. and — 12.5 per cent., or periods of a total of 18.2 per cent. The maximum deviations for five minutes are + 5.3 per cent. and — 8.4, giving a total of 13.7 per cent.

(To be continued.)

"Plowing the Water" for Platinum.—A curious method of producing platinum is reported to be practiced by the inhabitants of the villages on the Tura River in the Russian Government district of Tomsk in Siberia. They call this method "plowing the water." A raft is constructed and an inclining gutter of boards fastened to it, which at its lower end is provided with an iron plow. While floating down the river they scrape or plough its bottom. The sand scraped out falls into the gutter and passes into a tub filled with pine boughs, upon which platinum is deposited. The sand of the Tura River and its tributaries is so rich in platinum and its primitive production so profitable that the peasants are abandoning agriculture and devoting themselves to "plowing the water."

* Annales de Chemie et la Physique, 3d series, vol. xlv.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—EFFICIENCY OF AN ELECTRIC PLANT.

Electrical Age Pub. Co.

Dear Sirs:—Can I find out through your interesting columns whether the efficiency of an electiic light plant is figured from the coal to the dynamo or from the coal to the light of the lamps? I should think the efficiency low if the last is considered. Yours truly,

Oscar Long.

(A.)—Calculating from the coal burning in the boiler to the lamp itself we have about 1 per cent. left.

Boiler to engine,	12	per cent. left.
Engine to dynamo,	10	" "
Dynamo to wires,	9	" "
Wires to light,	1	" or less.

(Q.)—ENGINE STARTED WITH LOAD.

Philadelphia, Nov. 8, 1896.

Dear Editor:—Is it the best thing to start the engine with a good load of lights on, or better to wait until the dynamo is up to pressure and then switch them in? We have been arguing this matter and want your opinion.

Yours respectfully,

John Corrigan.

(A.)—Always start the engine with no load and switch the lights on gradually.

(Q.)—A SPUTTERING COMMUTATOR.

Binghamton, Nov. 10, 1896.

To Electrical Age.

Dear Sir:—My dynamo sputters at the commutator at full load. I have tried everything without stopping it. Your opinion would be valuable to me if I could get it. Kindly answer. Yoursobediently,

Walter Kranz.

(A.)—You might turn down your commutator, shift your brushes or strengthen your field and avoid the trouble spoken of. If they do not help you, examine the commutator for loose bars. If this examination proves the machine to be mechanically good, the sparking is possibly due to a heavy self-induction in the armature, which may only be reduced with a stronger field and carbon brushes.

(Q.)—BUCKLED BATTERY PLATES.

Atlanta, Nov. 1, '96.

To the Editor.

Dear Sir:—Having bought a few storage cells to experiment at welding with, I discovered, after a short time, that the plates were crumpled and bent.

I understand the technical term to be buckling for such an effect. Can you tell me something more about its cause? Yours very truly,

Alexander Winden.

(A.)—Buckling of the plate is caused by the sudden strain of rapid discharge. A rush of gas is supposed to be the cause; that is, gas previously condensed in the porous matter of the plates, which, suddenly set free, creates a great mechanical disturbance, namely, a distortion of the plate.

Body Permeated with Magnetism.—The body is unconscious of magnetism. It is totally unaffected when present in a magnetic field, even though the field may be capable of sustaining tons of iron. The rigidity of the medium seems to have no influence upon the body. A magnetic field is invisible and imperceptible in every sense except by its effect upon iron or light. The solidity of ether has never appealed to the human body, and in all probability never will, except by its effects, called light, heat and magnetism.

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CONTENTS.

EDITORIALS ....

Plating Alloys 667

Condensed Hydrogen 667

GENERAL SUBJECTS ....

Storage Batteries 661

Ambroin, A New Insulating Material 664

Standards of Light 665

Street Railway Trucks 667

The Underground Trolley 670

What the Trolley Meets With 673

MISCELLANEOUS ....

Telephone Fees May Come Down 668

Electricity as an Aid in Detecting Flaws in Iron Forgings 671

A Cable Attached by Termites 674

Occluded or Metallic Hydrogen as a Source of Electromotive Force, 675

National Commercial Travellers' Fair 675

TRADE NOTES ....

The New Scott Electric Search Light 669

Electric Stock Quotations 676

How Air Circuits are Completed 671

McLeod, Ward & Co 674

PATENTS 666

CONDENSED HYDROGEN.

One of the earliest experiments noted in the volumes of scientific lore is the absorption of hydrogen by platinum. The contemplation of this operation brings us nearer to one of our great commercial problems than any other that may be recalled. The experiment is merely that of exposing platinum sponge, that is, finely divided platinum, to a jet of pure hydrogen gas. The platinum immediately glows with heat as though affected by a stream of matter having intense calorific power. A spiral of fine platinum wire heated red hot and exposed to the escaping gas of an ordinary burner will sustain the redness of the spiral. It is supposed that gas is condensed under such conditions and therefore develops the heat thus exhibited.

In our modern storage battery one of our greatest objects is the obtaining of a spongy surface of lead. There is no doubt that the gas due to decomposition, after it has entered into certain chemical reactions, becomes absorbed or occluded in the lead plate. The bursting or expulsion of plugs of oxide, under the conditions of heavy discharge, add weight to this idea; and the fact that the volume of occluded gas leads, the greater it becomes, to a condition of heavier condensation and consequently greater electrical capacity and pressure, assists the belief that in all probability the two gases, oxygen and hydrogen, would if separately confined under enormous pressure develop some astonishingly new electrical phenomena. The electromotive force developed might increase with the dynamic pressure, and the present method of charging, as well as plate construction, modified to make use of this fact. If one of our large storage battery concerns would try this experiment, the storage cell of the future might consist of two aluminum tanks connected by a pipe and filled with gas under high pressure.

PLATING ALLOYS.

The difficulty of plating alloys has been reduced of late by a nearer acquaintance with the electrical properties of metals. The electro-chemical equivalent of a metal merely enables us to calculate the amount of metal deposited in a given time with a known current. It is therefore seen that, with two metals, the difficulty of depositing sufficient to form the desired proportion is enough to hinder the novice from attempting the experiment. In such work, however, the control of the current and pressure on certain lines makes the work comparatively easy. If a brass deposit is desired from a given solution and brass anode, a certain point is reached when the deposit is neither white nor red; that is, there is neither too much zinc nor copper passing over. Excessive pressure carries the zinc, or the converse carries too much copper over. The middle point of best action is determined by experiment only, because change in the electrolytic density throws out of order the previous results and by modifying the resistance of the bath necessitates a change in the voltage applied.

THE ENERGY LOST IN WHIRLWINDS.

A contemporary of ours, "London Invention," publishes a rather interesting note on the possibility of using a little of the waste energy of nature.

"Rather a novel project was that advanced by M. Raoul Pictet at the recent Geographical Congress at Geneva, which was no less than the utilization of the energy of the lofty whirling pillars of sand that are continually travelling over the desert of Sahara. These may be studied in the environs of Cairo, where, at about 9 A. M., bits of paper or feathers on little hillocks are occasionally stirred in a circular path, the movement gradually becoming steady and gyratory. Then the light objects rise, their velocity increases, and they are lost to sight in the sand that mounts after them, and may reach a height of 4,000 yards in about an hour. The upper part of the column is 400 or 600 yards in diameter, its narrowest portion about a dozen yards. Often ten or twelve of the columns are in sight at once, and their maximum force—depending upon their temperature—is reached between noon and 3 P. M. Some of the light objects picked up were afterwards found 15 or 20 miles away. The temperature was investigated by means of thermometers over a radius of 500 yards on the ground where the column was expected to form, and the sand was found to be 15 degrees or more hotter than the air, the heat—especially on the eastern side—increasing very rapidly at the beginning of the phenomenon. M. Pictet has been calculating the wasted heat for each column, and finds that it is sufficient to raise the temperature of a quart of water about 10 degrees in a minute. He therefore suggests that the solar energy thus dissipated be collected by covering the ground with immense heaters of blackened sheet iron. He calculates that Nile water flowing through such heaters could be quickly raised from 70 degrees to 160 degrees, and that a boiler covering two and a half acres would furnish 2,000 horse-power for irrigation and other uses."

Brass-armored Insulating Conduit, not Compound, as misnamed in the last number of this journal, is meeting with a big demand. The Interior Conduit and Insulation Co., 527 West 34th street, N. Y., announce a reduction in the price of their brass-armored conduit. See page 673.

In our account of the Upton lamp, last issue, we beg to state that Mr. Bramhall, formerly agent of the Upton Lamp Co., is now with the Diehl Mfg. Co., No. 561 Broadway. Mr. Haviland is at present the agent for the Upton Lamp Co.

STREET RAILWAY TRUCKS.

JOHN A. AKARMAN.

These first trucks, although involving nearly all the essential features of the modern trucks, were by no means perfect, and the conditions of the service soon suggested modifications. The first of these was to make the removal of the wheels and axles as easy and practicable as they had been with the jaws and oil boxes used on the old horse cars. The form which the improvement took was the making of the jaws a part of the motor-truck frame, so that, upon jacking up the truck, the wheels could be rolled out. This was an essential feature recognized by all truck builders, and has been embodied in every successful truck which has been constructed.

Up to this time brakes have been invariably hung from the body of the car. But it was soon found that brakes upon electrics were a very much more important feature than they had been upon horse cars. The high rates of speed and greater weight of the cars not only made stopping more difficult, but the shortness of stops to avoid accidents was found to be important. The brakes were first suspended from the sills of the car, and the sinking of a body under a load left the shoe so far from the wheels that in applying the brakes the slack of the chains was increased and could not be taken up without considerable delay. The remedy was simple, and consisted in suspending the brake rigging from the axle-box frame in such a way that it was not subject to the action of the body springs.

The change in the brake rigging from the car body to the truck frame brought another evil which had been of slight importance heretofore. This was the longitudinal rocking or pitching of the car body, technically known as galloping, which was greatly increased under higher speed, and is also further increased by lengthening the car bodies. This motion is not only excessively unpleasant to passengers, but very destructive to the trucks, motors and track. When the brakes were hung from the car body it was possible to check this oscillation by a slight application of the brake; but the change in the hanging of the brake made this impossible, and remedies became imperative. The first thing that was done as a remedy was to increase the wheel base, but this did not prove to be of much advantage. The first success as a remedy appears to have been made by extending the sides of the truck, and on the extension pieces mounting an elliptic or half elliptic spring. The latter method with the half elliptic spring has been the most successful preventative tried. The necessity for overcoming the oscillation was considered so important, and the success of this device so great, that a series of inventions were, and are being, brought out for the purpose of accomplishing the same result. Numberless combinations of elliptics and spirals, and springs of various kinds were made; and also a large number of inventions involving the use of levers, cross-equalizing bars, and other similar mechanical devices have been made, some of which appeared to succeed, but in most cases failed to produce a satisfactory result. Some of these devices in overcoming longitudinal oscillation very frequently caused the car to ride very stiffly and produced an undesirable effect upon the track. Others gave the car too much lateral motion, apparently, by the conversion of the longitudinal oscillation into a side or lateral movement. The so-called extended spring base which is combined with the half elliptic springs has, in my judgment, been the best solution of the problem up to the present time. It is conceded that the equalization of the wheels to carry the load according to the practice on steam roads is out of the question with a car which has only four wheels.

As time went on and experience was gained one point was gradually made more and more evident, which was that a motor truck was a locomotive in every sense of the word, and for success must be governed in its construction by the same general principles that are involved in the construction of a locomotive machine. The greatest difference between the functions of a motor truck and a locomotive seems to be the fact that a motor truck carries the load instead of drawing it. It also has to preserve its propelling machinery in perfect alignment while it is moved forward by the revolutions of its axles, and is subject to combined vertical, horizontal and twisting strains of the most severe kind, and at the same time it must ride as easily as a carriage. It has been demonstrated that a composite truck frame is a failure because of its inability to stand all the strains imposed upon it. The braces, which were amply sufficient to carry the weight, give it no strength to resist twisting strains; then, again, malleable iron parts break, bolts and nuts become loose and rattle, and it is next to impossible to prevent rivets from shearing and bars from twisting out of their place. The composite frame demonstrated its imperfections with the locomotive years ago, and has been found even less successful as a form of construction for a motor truck. This is due in a measure to the fact that, on account of cost, first-class workmanship is out of the question in building a low-priced truck. The truck frame consisting of a solid forged bar, of course, gives greater strength to resist strains thrown upon it from all directions than any form of a built-up truss.

(To be continued.)

TELEPHONE FEES MAY COME DOWN.

Washington, Nov. 9, 1896.

The case of the United States against the American Bell Telephone Company was argued in the United States Supreme Court today. The case involves the validity of the Berliner patents, owned by the Bell Company. Attorney-General Harmon, Solicitor-General Conrad and attorneys representing special interests, appear in connection with the suit of the United States, while the Bell Company has a heavy array of counsel, including James J. Storrow, Joseph H. Choate and Frederick P Fish. The Standard Telephone Company is represented by General James McHaught and Myron Francis Hill, who have filed a brief on two points in behalf of the Government. The Standard Company has no direct interest in the litigation, except as it affects the general use of telephones.

It is said that a decision in favor of the Government would tend to open the telephone to public use. Owing to the importance of the interests involved, the court granted nine hours for argument, which will continue the case for about three days.

Judge R. S. Taylor, of Indianapolis, opened the argument today in behalf of the United States. The suit began in February, 1893, when the Attorney-General filed a bill in equity against the American Bell Telephone Company and Emile Berliner, asking for the annulment of the patent. The Berliner application was filed on June 4, 1877, but the patent was not issued until fourteen years after. The main points raised by the United States are that the patent is void for illegal delay in its issue, and that it is also void on the ground that a prior patent was granted upon the same application to the same applicant for the same invention.

Rumors of a prospective telephone war were in circulation in this city yesterday, brought about by the possibility of an adverse decision to the Bell Telephone Company in the Berliner patent suit. Coupled with this was the fact that a contract which had existed between that company and the Western Union since 1879 had not been renewed after its expiration on November 6.

It was rumored that each of the companies intended to invade the other's territory with rival telephone and telegraph lines.

One of the officials of the Western Union Company said yesterday that the directors of that company never had discussed competing with the telephone companies.

He did not see that there was any possibility of a telephone war, as each company needed any surplus capital it might have to develop further its own interests.

The failure to renew the contract was explained on the ground that there was no necessity for it. In 1879 the Western Union leased the right to certain telephone patents to the Bell Company. These patents lapsed one by one, and when the contract expired there were no patents remaining.

The relations between the two companies, according to the officials of the telegraph company, are most amicable. They have an exchange system by which telegraph messages are delivered by telephone, and in many places the offices of the two companies are in the same building.—N. Y. Press, Nov. 10.

THE NEW SCOTT ELECTRIC SEARCH LIGHT.

The New York Herald of Aug. 26, 1896, published the following article in connection with the Scott lamp, whose good work in the past as a pioneer and in the present as a most advanced type of lamp deserves the greatest credit:

"An interesting spectacle was afforded the persons along the river front when the big search light on the roof of the Columbia Machine Works building, at No. 18 Columbia Heights, was tested on Monday night. Shafts of light were thrown in every direction from the lamp. The trial of the huge light was conducted by the Scott Electric Lamp Co.

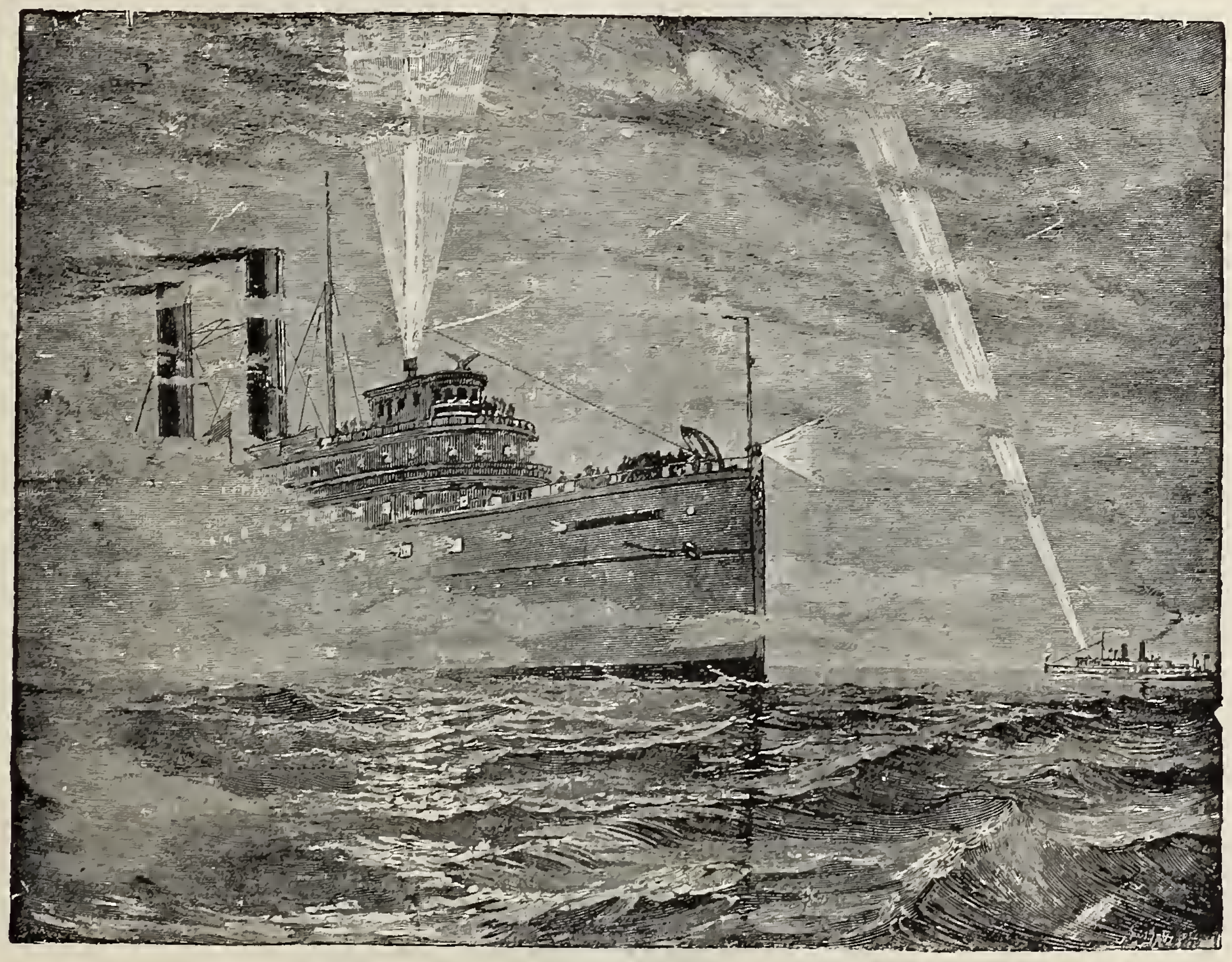
"The lamp projects a ray of light of 1,000,000 candle-power. It required two weeks to construct. The lens which focuses the light from the arc is twenty-six inches in diameter, and from one inch thick at the centre to one and three-quarters inches at the edges. It was imported in the rough from Paris, and ground by a Rochester firm.

"The carbons are automatically fed and are one inch in diameter. When the current is turned into the lamp a small portion of it is shunted into a magnet contained in the lamp. The magnet draws the carbon apart, forming the arc. Through this arc of vaporized carbon an immense light is produced. As the carbons burn away gravity brings the upper rod close to the lower one, and the strength of the magnet is so adjusted as to counterbalance the effect of gravity, thus automatically maintaining the distance between the two rods and keeping the length of the arc uniform.

"The lamp weighs about sixty pounds. The power to operate it was obtained from the Edison street mains. The voltmeter showed an electromotive force varying from forty-eight to fifty volts during the test. The current used was about one hundred amperes.

"The test was successful. A flash of light was thrown over both cities and down the bay. The minutest details transpiring on the decks of vessels and the roofs of houses two miles away were easily observed.

"The lamp was ordered by a Kansas firm—which in turn secured the contract from a large wholesale dry goods house—who will use the lamp as an advertisement. The lamp will be shipped today."



Scott Search Light on Sound Steamers.

—The following letter has been received by us which we publish in full. Our friends are invited to send in subjects for review or discussion in harmony with the following:

The American Street Railway Association.

Chicago, October 31, 1896.

Dear Sir:—The Executive Committee requests that you will kindly suggest topics upon which you consider it would be desirable to have papers written and presented at the Sixteenth Annual Meeting of the Association. We should also be glad to receive any suggestions as to whom should be assigned the duty of preparing such papers.

This matter will be considered by the Executive Committee at a meeting to be held in the very near future, and I should be very glad to receive your suggestions at an early date. Yours very truly,

T. C. PENINGTON, Sec. and Treas.

Boardman River Electric Light and Power Company.
Traverse City, Mich., Sept. 11, 1896.

Automatic Circuit Breaker Co., Newaygo, Mich.

Gentlemen: We enclose check to cover enclosed bill. Please receipt bill and return. We are very much pleased with circuit breakers and feel confident that they have repaid us. Yours truly,

Boardman River Electric Light and Power Co.

Many of our great sound steamers have been equipped with a Scott search light, as seen in sketch, and likewise many outgoing steamers, coasters and transatlantic vessels. The Scott Electric Lamp Co. have their office at No. 126 Liberty street, N. Y.

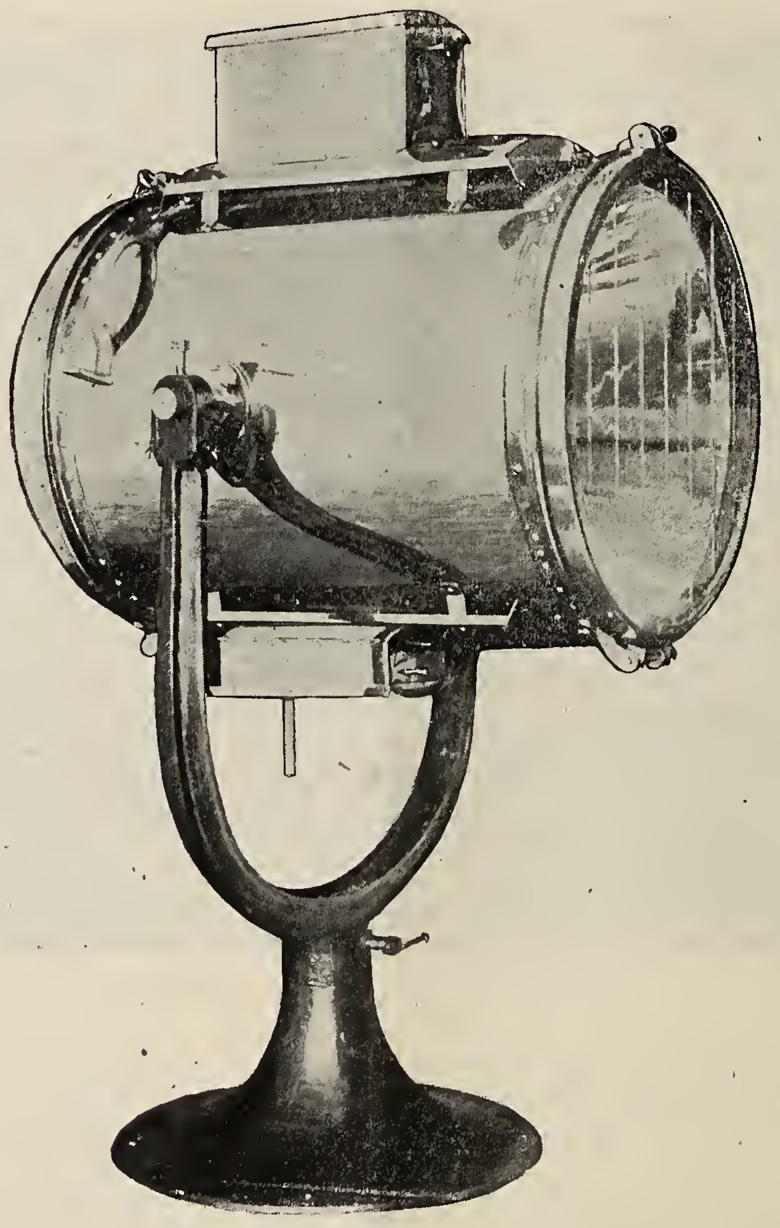
THE UNDERGROUND TROLLEY.

BY M. D. LAW.

It may be of interest to the readers of the "Electrical Age" to know that the underground trolley has passed the experimental stage and has become an unqualified success.

feet each, with an expansion joint to each length; this joint is made so that it has a much larger conductivity than the remainder of the conductor, and will keep bright and free from corrosion under all circumstances. The arrangement of the conductor is such that a bar can be taken out and a new one substituted in four and one half minutes, so that should a bar become injured it would cause but slight delay; but the construction of the trolley is such that it is impossible to injure the conductor in any way, for if a car derails the bottom of the trolley is pulled off by the protecting lip of the slot-rail without injury to the conductor.

It has been claimed by those operating the Lenox avenue system that when a trouble occurs it takes two days to find it and five minutes to repair.



New Scott Electric Search Light.

March 2, 1892, a road was put in operation in Washington, D. C., equipped with the Love system, and has been operated through three winters with no difficulty from heavy snow, other than surface trouble, such as any trolley road will meet.

From the experience there a much improved road was built in New York for the Third Avenue Railway Co., as an extension of the Amsterdam avenue cable line. This road was put in operation May 9, of the present year, and has given perfect satisfaction.

For nearly five months there has been no trouble of any kind. Each one of the trolleys has now made 9,000 miles of run, without any trouble, other than of bushings in the wheels.

There are many improvements in the New York construction, especially such as facilitate repairs.

All insulators can be reached from the surface; and should it become necessary to change an insulator, it can be done without any delay to cars, as it takes but three minutes.

The conductor is of copper and is from 500,000 to 1,000,000 C. M. capacity, and is made in sections of 13½

The Love system is so arranged that should a ground occur it can be located and removed in from fifteen to thirty minutes, without any delay to the cars.

It must be remembered that a metallic circuit is used, so that a ground on one side of the line will not in any way interfere with its operation.

The system has been in operation long enough, so that there is no question but that the insulators will last five years before any of them have to be removed.

The trolley has been so simplified and perfected that it is cheap in construction and easy to keep in repair; its insulation has been so improved that it can be run through any amount of wet weather without leak and will stand salt and snow without trouble. This is the worst possible test for it, as experience has shown that with salt and snow on the trolley it will burn out, unless there is more than two inches of insulation.

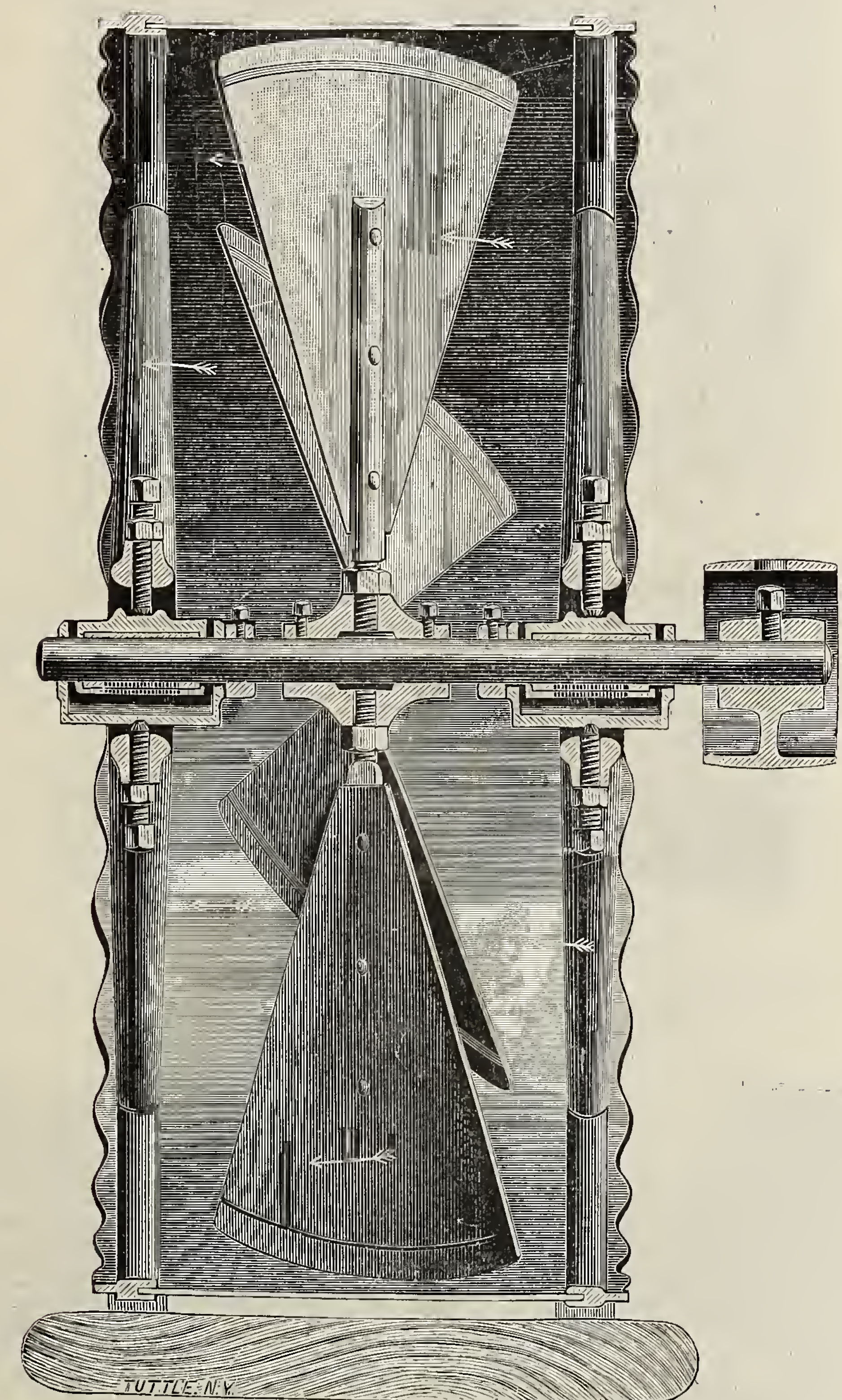
With the perfected trolley as now operated there is six inches of insulation, and as much more may be used if found necessary.

Experience has shown that this system of underground trolley can be operated with much less expense than the

overhead or grounded system, there being no loss between wheel and rail or from bad bonding, as the current is carried in both directions by insulated copper conductors. There is no loss of current through the insulators, as can be easily proven by a visit to the power house.

Work will soon be started in Chicago on a large amount of road to be equipped with underground trolley, the same as in operation on Amsterdam avenue in this city.

flection of the galvanometer will be noted, thus indicating the presence of an internal breach of continuity in the ingot. Our able contemporary, The Electrical Review, in commenting on the absurdity of this suggestion, very correctly remarks that no such sudden change could possibly take place; the slight reduction in the conductivity of the mass at the flaw would be infinitesimally small, and would not have the slightest perceptible effect on the galvanometer.



Sectional View of Wing's Adjustable Blade Disc Fan.

ELECTRICITY AS AN AID IN DETECTING FLAWS IN IRON FORGINGS.

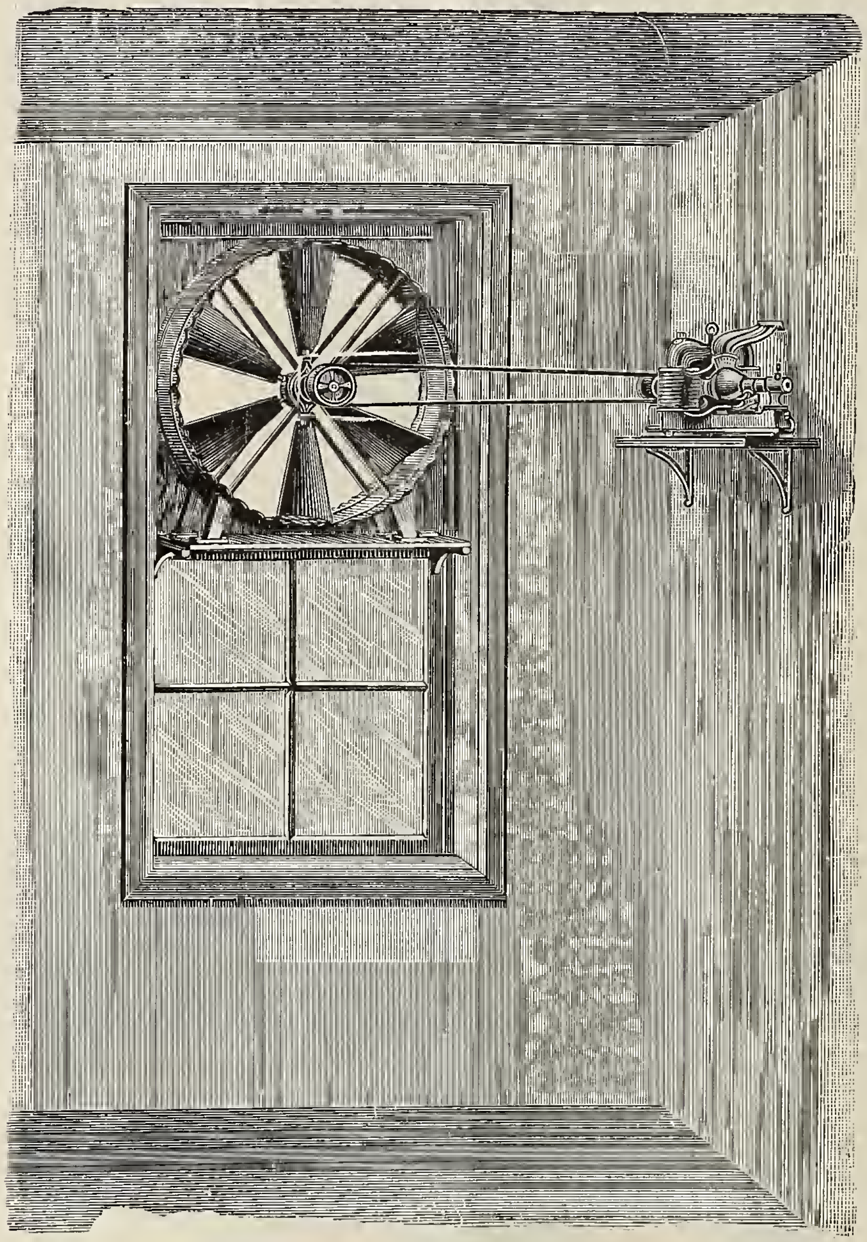
A series of excellent papers have recently appeared in some of the technical journals on "The cause of fibrousness in wrought iron and crystallization in mild steel," by Mr. W. F. Durfee, and while the information given, if not altogether new, is at least valuable to those studying this subject, one suggestion put forward by the author is altogether too finely drawn to be of any value in practice. Mr. Durfee thinks that the position of an internal flaw in an ingot may be determined by noting the deflections on a galvanometer. He says that when the wire passes a point opposite the rupture the law of increase of deflection will suddenly change, and a considerable increase of de-

HOW AIR CIRCUITS ARE COMPLETED.

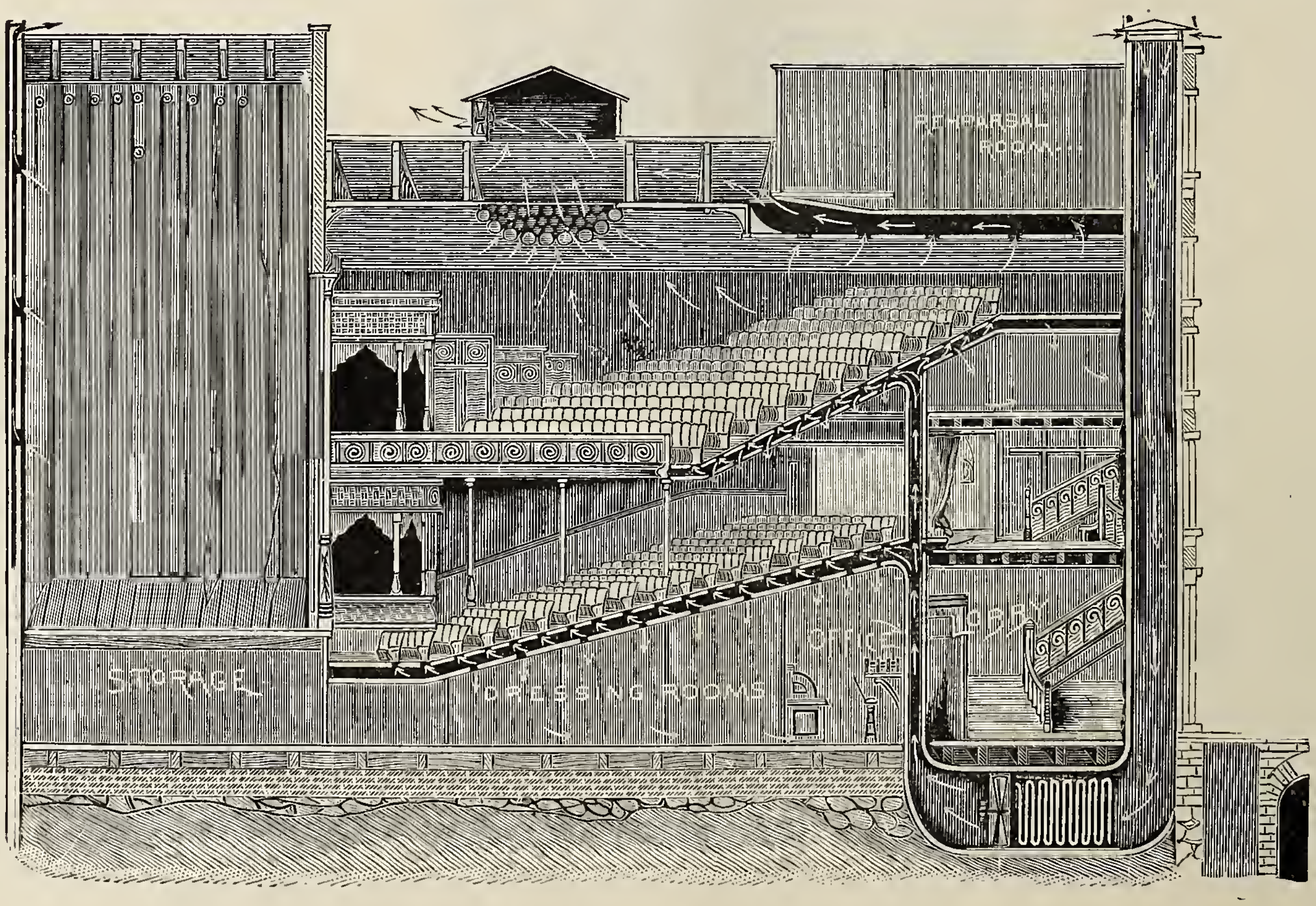
For many years the firm of L. J. Wing & Co. have enjoyed the reputation of being expert in the art of ventilating buildings. They have not only studied the subject with an eye to the future, but constructed fans of all descriptions and installed ducts in buildings to carry the hot and vitiated air to points of exit.

The engraving represents a fan as designed by L. J. Wing in position in the window. This is the cheapest and quickest way of obtaining good ventilation, the air entering and leaving freely. Likewise it may be seen that the fan as made by Mr. Wing does not obstruct the light, the blades being so excellently designed that this objectionable characteristic is removed. The simplicity of the

outfit, which includes a motor requiring no care, a fan requiring less gives us a ventilator needing the least possible attention. A very valuable feature of the fan designed by Mr. Wing is the adjustable blade. The exhaustion of air during winter, that is, the expulsion of warm or foul air, may be readily changed in summer by means of these adjustable blades to a cool, refreshing breeze blowing into the room and controlled at will from a gentle southern zephyr to a whistling whirlwind. An engine or motor will be found most convenient for driving these fans. The Lyceum Theatre in New York was ventilated by L. J. Wing & Co. In the longitudinal section



Wing's Disc Fan in Position in Window.



Wing's Disc Fans and Ventilating System in Lyceum Theatre, N. Y.

of the building the passage of the air may be traced from point to point, entering at the top of the building at the right, passing the coils used for either heating or cooling it, forced along by means of a Wing fan into the orchestra, balcony, etc., then being driven out at the top by another fan into the outer air; the circuit it has travelled over being in every sense complete. Mr. Wing has exhibited his competency to scientifically ventilate buildings by years of good work in New York and other large cities in the United States. The firm he represents sell exhaust fans of the 48-inch size supplied with ducts or outlets for the removal of foul air, and, in addition, a motor for driving the same. Hot kitchens, basements and places otherwise excluded from the possibility of rapidly getting rid of moist and foul air find in these fans a treasure of inestimable value. The Wing disk fan, used for forcing the air into a room, is 60 inches in diameter and is driven by an engine of appropriate size and speed. L. J. Wing & Co. make fans of a variety of sizes, from 12 inches up, on demand; they undertake the complete ventilation of buildings and guarantee to improve the hygienic conditions existing in any place due to a lack of proper air circulation. It would be well for those who contemplate improvements or changes in either stores or buildings to confer with Mr. Wing regarding the plans they have in view, as his experience is of a deep and practical nature, and the firm he represents is equal to any emergency. Their store and salesrooms are at 109 Liberty street, New York.

A Snow Bound Trolley Car.

On the New York Central you travel in perfect security, protected every foot of the way by Block Signals.

Six Months After; No Visible Difficulties.

WHAT THE TROLLEY MEETS WITH.

At times, strange though it may seem, the public demand service when the very wrath of heaven is pouring down. The two antipodes of conditions is displayed before the reader's eye in the two cuts shown. If the famous blizzard of New York had struck us when equipped as today, some of our vaunted cable systems would have quickly come to grief. It seems, however, from one of the sketches shown that the trolley car made desperate efforts to get ahead.

The contrasting bliss of the other sketch displays the

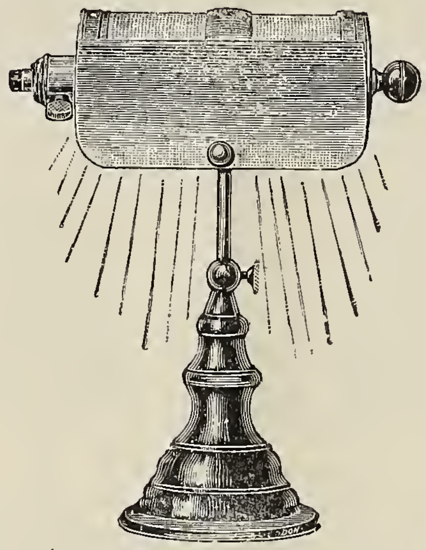
Brass Armored Insulating Conduit.

warmth of August weather; that is, as nearly as it may be thus represented. We have heard from reliable sources that with clean snow on the tracks the insulation is sufficient to prevent progress. It is easily seen that with enough snow of any description this is likewise true.

A CABLE ATTACKED BY TERMITES.

The French telegraph department has recently had to examine a cable which, laid in July, 1894, had begun to leak at the beginning of the following year, and had to be replaced early this year. It was a well prepared and insulated armored cable, containing three conductors of seven strands, and came from Haigshong in Tonquin, where the authorities had been unable to discover to what causes the damage might be due. The cable was embedded in cement, and placed in ground somewhat damp with salt water, only a little elevated above sea level. Bouvier, to whom the specimens were submitted, discovered little galleries, $\frac{1}{12}$-in. or a little more in diameter, hollowed out in the jute and cotton, then passing into the gutta-percha, and finally baring the copper wires. Two heads of termites were discovered. How they got into the cable is not clear; they could hardly have eaten their way through the lead sheath, although termites accomplish a good deal. It seems more likely that they penetrated from the open ends, or from a spot where the lead had been injured. It would be advisable in any case to cap the ends, to protect the junctions as carefully as possible, and also to impregnate the cotton and jute with sulphate of copper. This is what Bouvier recommends in his report to the French Academy. The impregnation with copper sulphate may, however, be objectionable.

By the electrolysis of a solution containing one part of silver sulphate, 2–3 parts of silver oxide, and 120 parts of a 10 per cent. solution of ammonia, using mercury electrodes containing silver, Mr. T. Gross, an abstract of whose paper appears in the "Journal of the Chemical Society," obtains the separation at the anode of a grey mass, which is colored white when heated with nitric acid, also mercury when heated alone, and leaves a brownish-yellow fusible residue. This residue appears to contain an entirely new substance, which Mr. Gross regards as a decomposition product of the sulphur contained in the silver sulphate. After removal of the mercury and silver present, a dull grey powder is obtained which is insoluble in nitric acid, and dissolves in aqua regia to a yellow liquid, giving with hydrogen sulphide in the slightly acid solution a brown precipitate somewhat soluble in ammonium sulphide. This brown precipitate when heated loses sulphur, and the original grey powder is recovered.

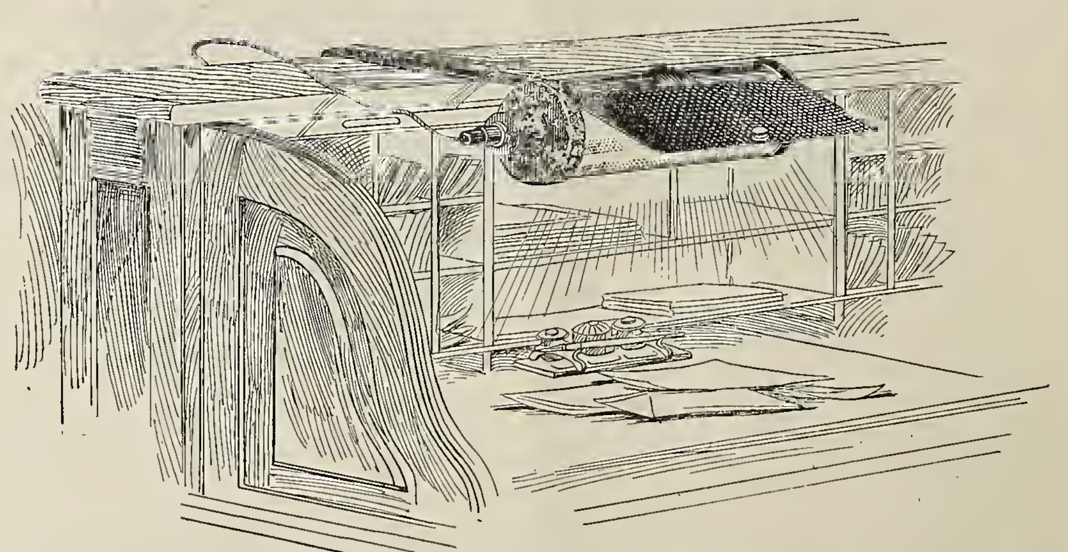


Kinsman Portable Desk Lamp With Shade Down.

McLEOD, WARD & CO.

The firm of McLeod, Ward & Co., of 27 Thames street, New York, manufactures an extensive variety of electrical appliances.

They have recently brought out a new "Kinsman" desk lamp, which embodies all the well-known features of their original nickeled desk lamp introduced three years ago, *i.e.*, the adjustable eye-shade, revolving glass cylinder and telescoping tube. The new desk lamp is completed with a dark green enamelled finish touched up with gold stripes.



Kinsman Desk Lamp in Position.

This shade is made particularly to meet the demands where a highly ornamental desk lamp is not desired, its list price being one-third less than that of the ornamental type.

It is a most convenient form of lamp, sending down a strong but well-modulated light upon the book or paper without endangering the eyes or producing other than a pleasing brightness. For a long time it has been known

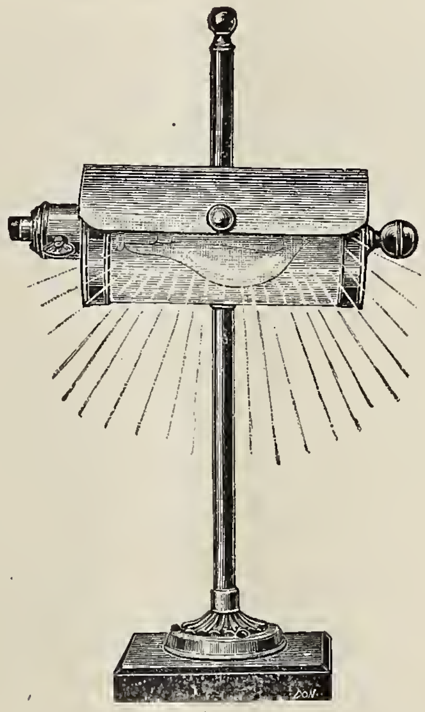
to the trade as a most serviceable lamp of excellent construction, in every case living up to the buyers' expectations.

OCCLUDED OR METALLIC HYDROGEN AS A SOURCE OF ELECTROMOTIVE FORCE.

The following is an interesting little article taken from "Invention," of London, written by H. N. Warren.

As regards the active properties of nascent or occluded hydrogen, so exhaustive have been the researches that have covered the pages of scientific literature of late, that to attempt to explain further the negative law of that element, especially with regard to chemical synthesis, would undoubtedly be out of place. But on the other hand, as a direct motive power, it is the author's intention to foreshadow to electro-scientists the employment of that element in place of zinc, in order to excite primary currents. Of all the metallic elements that amalgamate with, or form a pseudo alloy with, hydrogen is palladium. Here the costliness of that element is the first and greatest bar. Next in the rank of metallic absorbents stands spongy lead, a fact that is well known to all who use electro accumulators, and it is thus by the combined aid of these elements that a further electromotive power is introduced, whereby a primary current can be established without the use of zinc.

Taking advantage, then, of these facts the author proceeds to construct a sensitive negative, by procuring a cylindrical plate of spongy lead; this is rendered active with hydrogen gas, by immersing the same for a few hours in dilute vitriol, having been previously attached either to a piece of amalgam zinc, or ordinary iron, the plate being afterwards taken from the maternal solution and further immersed in a dilute solution of palladium chloride. An energetic action at once takes place, metallic palladium being deposited throughout the porous lead and rendering it thereby extraordinarily active, insomuch that small plates only 5-in. by 3-in. have been observed to absorb and retain, with great tenacity, several times their capacity of hydrogen gas. Having thus obtained the sensitive negative, all that is required is to insert the cylinder in a convenient sized porous pot, the outside of which should be furnished with ordinary boron-carbon plates, and excited by the usual depolarizers. A powerful primary current is thus obtained, giving an E.M.F. of practically two volts, a cell so constructed 7-in. by 5-in. maintaining a current of 16 amperes.



Kinsman Portable Desk Lamp With Shade Up.

The Gordon-Burnham Battery Co. manufacture the Gordon-Burnham battery, No. 82-86 West Broadway.

NATIONAL COMMERCIAL TRAVELLERS' FAIR.

The National Commercial Travellers' Fair to be held in December 15–26 inclusive, at Madison Square Garden, New York, which aims to raise a fund of $150,000 with which to raise the National Commercial Travellers' Home at Binghamton, N. Y., has already so far progressed that it needs no introduction to any trade journalist.

The chairman of the Fair Committee is Chauncey M. Depew, LL.D. Vice-presidents, Hon. Wm. L. Strong, mayor of New York city; Hon. Roswell P. Flower, ex-governor of New York; Secretary, R. G. Dun, Esq., and Treasurer, Hon. George E. Green, mayor of the city of Binghamton, N. Y., and president of the Commercial Travellers' Home Association of America. Col. A. B. de Freece is the director-general of the fair; Mr. Alfred Chasseaud, assistant manager, and Mr. Allen S. Williams, chairman of the Commercial Travellers' day committee and of the Press commitee.

The insuring of the fair's success can be done by the trade journals of America, with great credit and advantage. Press notices and cuts can be furnished, and also printed copy for a donated display advertisement. Above all, help insure a great popular observance of commercial travellers' day, Tuesday, December 1. Every hotel, theatre and business enterprise is asked to donate a percentage of its receipts and all commercial travellers and their friends to send a cash donation, however small, to the fair for the Home.

The fair has issued 200,000 season tickets at $2.00 each. Upon every ticket will be awarded some article of merchandise. Besides being beautiful souvenirs, these tickets are thus invested with a real value. The holder may not visit the fair, yet he is guaranteed a participation in the distribution of its valuable goods. It is obviously better to sell these tickets at a fixed price for cash than it is to take chances of selling goods at any price to fair-goers, or at auction. This fair will not, just at holiday season, compete at cut prices with the great retail stores of Greater New York, thus antagonizing them and arraying them against the manufacturers who generously donate to the fair.

Donations, some of considerable value, are flowing in, but owing to the plan described, a stock of goods far larger than any fair has ever received is required. This stock the trade journals can secure by appealing to the trades they represent for donations, and crediting to the donors those donations received.

It is desired to organize the trade journals, their publishers and editors, on these lines, and if all will agree to join in this plan it will settle in the affirmative the question: Will the fair succeed in securing the $150,000

requisite to complete the Home? It is the intention to benefit the trade journals by advertising them at the fair, and doing everything possible for their advantage. Director-General A. B. de Frece is receiving many assurances of co-operation. Every trade journal should enlist in this grand army, which, by an earnest but easily conducted campaign on the simplest of plans, can achieve a glorious philanthropic success, justly entitled to the best wishes of every American business man.

The free attendant service maintained by the New York Central at Grand Central Station, New York, is another example of the care and courtesy by which patrons of this great railroad are surrounded.

The autumn scenery of the Hudson River and Mohawk Valley lends additional charm to a trip over the New York Central at this season. Fourteen fast trains every day between New York and Buffalo and Niagara Falls.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
Edison Elec. Illg. Co., New York,	100	101
Edison Elec. Illg. Co., Brooklyn,	97	100
Edison Ore Milling Co.,	7¾	10
Edison Elec. Storage Company,	27¾	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co. T. Sec. Series A,	2½	4
General Electric Company,	34	35
General Electric Company pf.,	68	70
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	80	81½
Rhode Island Elec. Protec. Co.,	—	122
Royal Elec. Co. (Canada),	105	115
Toronto (Canada) Elec. Light Co.,	—	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse Elec. & Mfg. Co.,	25	27
Westinghouse El. & Mfg. Co., pf.,	50	51
Westinghouse El. & Mfg. Co., assd.,	—	—

*Ex dividend.

The big trio were in town this week. H. B. Cutler, of the Cutler Electrical Mfg. Co., Philadelphia; C. E. Bibber, of Bibber, White & Co., Boston, dealers in wire and specialties, and H. H. Brooks, of the American Circular Loom Co., of Boston, Mass.

Mr. Charles H. Lockwood, formerly of the Lord Electric Co., of Boston, was elected treasurer, and Frank L. Topscott, vice-president of the Gordon-Burnham Battery Co. at a meeting of the board of directors, November 11, 1896.

Elmer P. Morris, No. 39 Dey street, N. Y., has just closed a contract with the Simonds Manufacturing Co., of Pittsburg, Pa., for the agency of their steel and malleable gear pinions, trolleys, etc. Mr. Morris is an able and enterprising agent, and the Simonds Company have the proper articles for sale. Both will be appreciated by the trade.

—H. P. Copeland begs to announce that he has been for the past eighteen years connected with electrical interests in this city, and for the past six years with the late corporation The E. S. Greeley & Co., formerly in business at 5 and 7 Dey street. While with them he was in immediate charge of the catalogue department and the filling of orders; he is now in charge of the electrical supply department of Messrs. James S. Barron & Co., with offices at 147 West Broadway, and would be pleased to see you when in this market, or to receive any orders you may feel disposed to favor him with, or to answer any inquiries with regard to the purchase of goods. Any supplies that you may require from the "Greeley" catalogue he will be pleased to quote upon. The facilities of Barron & Co. enable them to offer you the most favorable market rates.

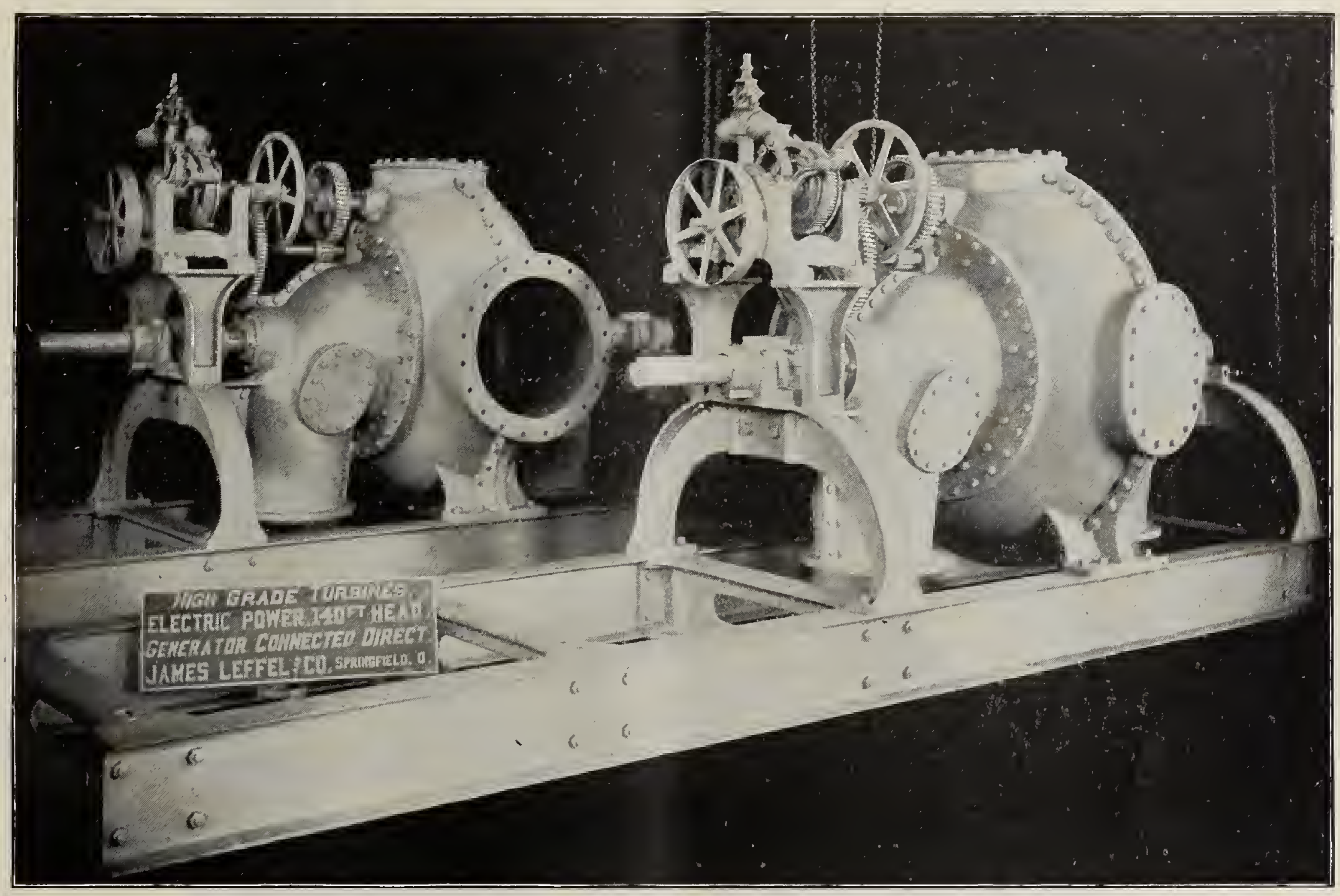
Stephen D. Field, of Stockbridge, Mass., inventor of the third-rail system, was in the city at the time of this writing.

Lundell motors are in the lead. Eleven motors of various sizes have just been sold to Andrew Wigman, the big printer of Rochester, N. Y. They will be direct-connected to the printing presses. The Interior Conduit and Insulating Company are to be congratulated upon the big orders they have secured lately.

A contract for twenty-five air compressors and twenty-five air receivers, of medium and small sizes, has been closed by the Clayton Air Compressor Works, Havemeyer Building, New York, with one company; delivery of the entire order to be made within six months from date. They also report sales of five air compressors of standard pattern during the first week in November, and the indications point to a decided revival of trade in air compressors, many orders having been held in abeyance pending the result of the election.

The Electrical Age.

Vol. XVIII., No. 21. NEW YORK, NOVEMBER 21, 1896. Whole No. 497



LIQUID POWER.

In these times, when a spirit of economy steals over every process of manufacture and helps to shape and mould the mightier engines of the day, it is well to pause and, in the light of this fact, consider well how far the point in view has been attained; whether the desire to economize has written its unmistakable signs upon the structures from which we get our motive power, or whether the innumerable types of power-producing machines confronting us betray this quality of mechanical thrift and commercial excellence.

Of all mechanical appliances for the transformation of power the turbine stands pre-eminent. As one of the earliest landmarks of country life the water-wheel is best remembered, and from this period, with its well of rural recollections, we pass rapidly onward to the improved and exalted type of turbine.

To merely pour water through a tube and let it escape from a series of orifices arranged around a circular periphery would be to duplicate the idea existing in many minds regarding a water turbine. While an essential principle may be observed, its modifications come but slowly and only through the exercise of patience, observation and long experience. Turbines have passed through many changes since their first application, and it may be said that the closest students of this subject may be found in the firm of James Leffel & Co., of Springfield, Ohio. They make *one hundred and forty* different styles of the same type, and have on hand the most perfect equipments, including machinery and patterns for carrying on their work.

The Standard, or old reliable standard, as they choose to call it, is made from the designs and drawings adopted by James Leffel; with certain improvements of considerable value we reach another style—

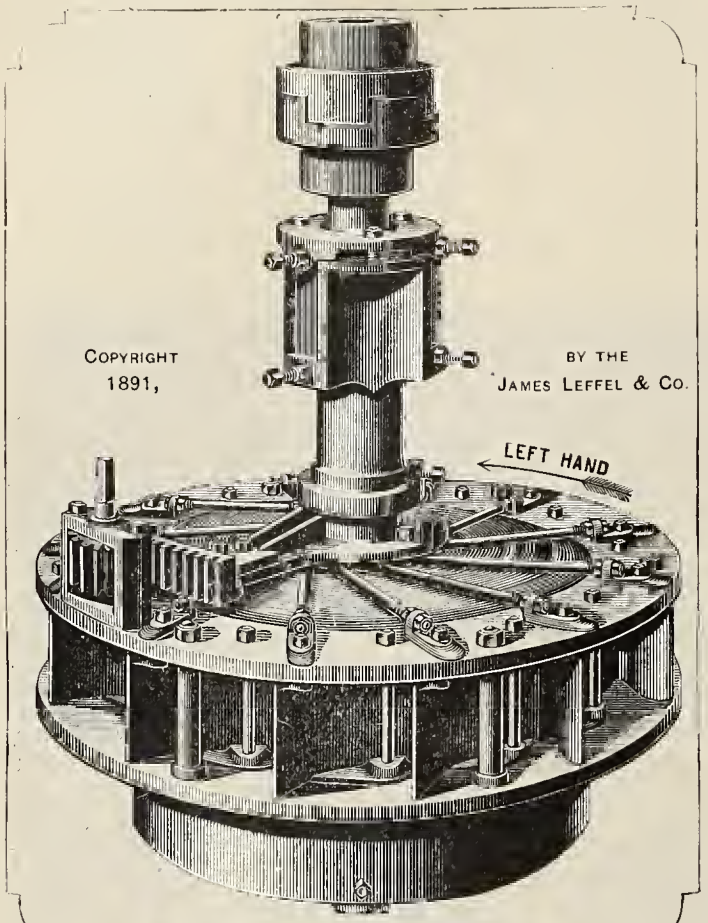
The Special, or, as it is called, the new reliable special, having wider buckets and gates.

By this means more water passes through and more power is produced from the same size of wheel. After years of daily operation they remain intact and perfect, attesting to their excellence and serviceableness.

Besides the turbines, James Leffel & Co. manufacture cascade wheels, some of which form part of the great Anaconda plant in Montana.

Electric lighting and power have been greatly assisted in

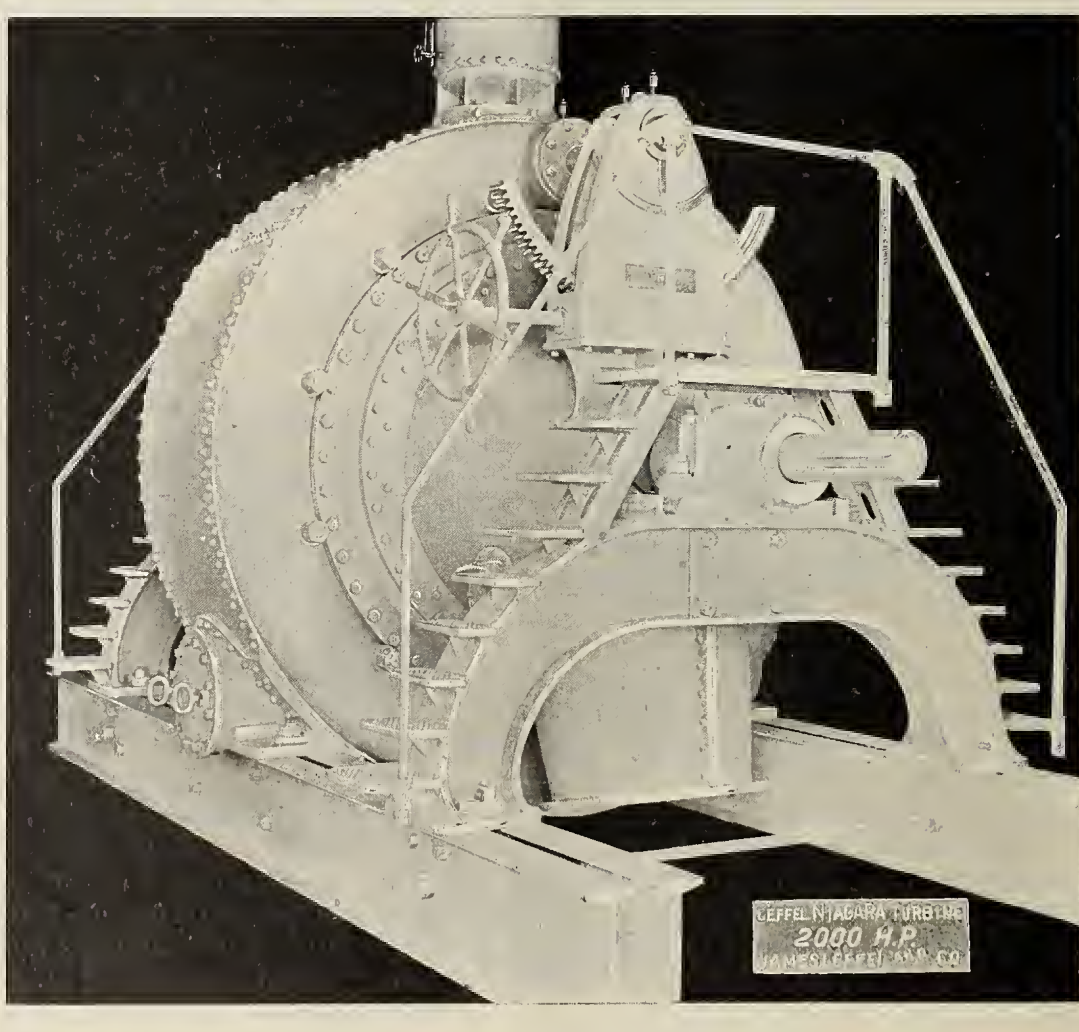
their development by the Leffel turbines. Many electric light plants and trolley roads would not be in existence today if it were not for the turbines, whose great econ-



STANDARD JAMES LEFFEL TURBINE.

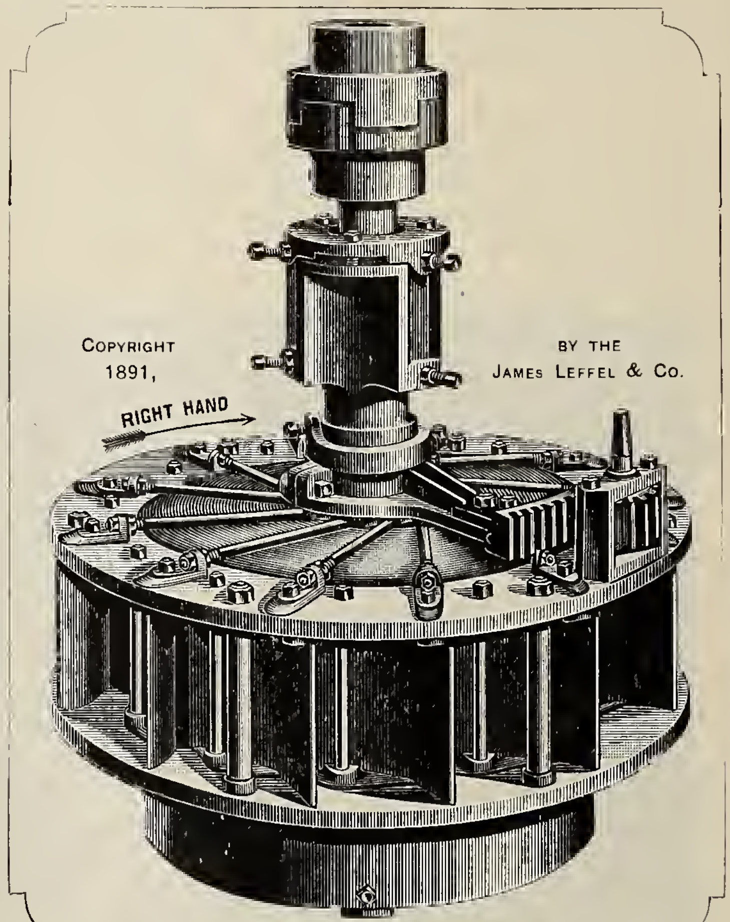
omy have made water-power electric plants a pronounced success.

Two thousand horse-power Niagara turbines, manufactured by them, have not required more than ordinary care wherever installed. The illustration shows one of these great power generators. Four of their Niagara type of double discharge wheels are being made to give 8,000



H.-P. when operating with a 218 foot head. The above mentioned Anaconda mine plant has wheels of similar type and design, but less power and smaller size.

Two Leffel double discharge water-wheels, comprising part of the four improved Leffel double discharge turbines installed in the Anaconda plant, are represented in the larger illustration.



SPECIAL JAMES LEFFEL TURBINE.

They are mounted on horizontal shafts; in the cut two are shown 26½ inches in diameter; the other two, 30½ and 17½ inches, are not shown but are identical in everything but size with the first.

Each turbine is automatically governed, and has given complete satisfaction in its operation and reliability. All of the Leffel turbines in this plant operate under a 140-foot head of water with direct-connected generators.

Many addresses will be given by James Leffel & Co. to those considering the installation of a power transmission line, railway or lighting plant, where water-power is avail-

able. The above company have made the closest examination of the conditions of turbine practice, and will, without hesitation, undertake to install plants of the greatest magnitude.

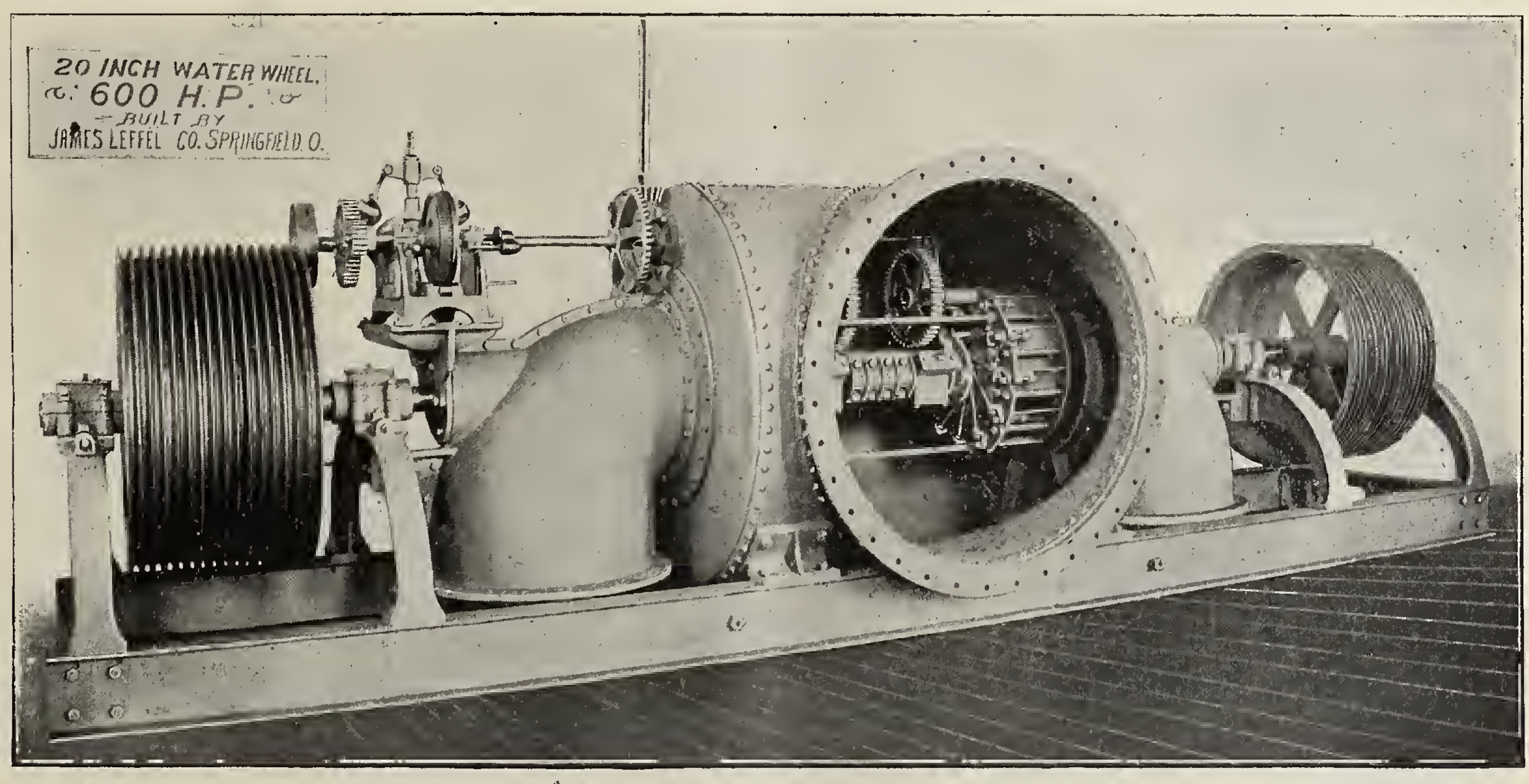
In the Philadelphia Record we hear of the composition of another electric insulator, which is described in the Electro-Techniker. This material is made from specially prepared fibrous silicates, thoroughly soaked and mixed with fossil rosin and then subjected to an exceedingly high pressure. The product is closely allied to vulcanite, which it resembles, except that it is somewhat brittle. Ambroin has been used for a great variety of articles for which horn, bone, celluloid, vulcanite, etc., have heretofore been used. It may be moulded without contraction, is practically weatherproof, possesses a high specific resistance and will withstand a fire test of 400 degrees Centigrade. Moreover, it is unattacked by acids.

The purification of water by electricity is just now engaging the attention of scientists. Experiments show that bacteria and microbes are effectually destroyed by electrical currents, and the water completely clarified; but a cheaper process than that under which the experiments have thus far been conducted must be found before electrical filtration can become a commercial success.—Boston Herald.

H. G. Rich, electrical engineer, has invented an "aerial torpedo" for use during the siege of cities. It consists of a small-sized, gas-filled balloon, inside the lower end of which is placed a metal cylinder containing an electrical device to ignite the gas in the balloon at any stated period. When this is done the balloon is destroyed, and the basket, containing high explosives, explodes when striking a hard surface.—Tribune of Salt Lake City.

TRAVEL UP TO DATE.

The New York Central offers unequal advantages for through travel between the East and West. It is the only trunk line entering the city of New York. Its Grand Central station is in the very centre of the metropolis, in the midst of the hotel, residence and theatre district; it is the only line protected its entire length by block signals; it has the fastest trains in the world; the finest equipment; scenery including the Hudson River, Mohawk Valley and Niagara Falls.



INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—TWO DYNAMOS OR ONE.

Philadelphia, Nov. 12, 1896.

To The Electrical Age Pub. Co.

Dear Sirs:—Can you inform me through the columns of your interesting paper whether a plant of 2,000 lights should be equipped with two 1,000-light dynamos or one 2,000-light capacity? By answering the communication at once you will greatly oblige. Yours respectfully,

Isidore Fleming.

(A.)—It is better to have two dynamos than one; if the lights act as a constant load, a large dynamo and relay armature would be sufficient. The only object in view in using two machines is to always have *one* in good order when the other fails, and to only run one when the load is light.

(Q.)—WIRING FOR ALTERNATING CURRENT.

Paterson, Nov. 14, 1896.

To the Editor.

Dear Sir:—In wiring with conduit tubing for alternating current I am obliged to use a larger sized wire than I would with continuous current. Can you tell me why this is so? Yours truly,

William Mackey.

(A.)—There is more self-induction in a wire carrying an alternating than one carrying a continuous current. That is, more reaction exists when an alternating current tries to force its way through the wire. We use a larger size to facilitate its passage.

(Q.)—ATTRACTION OF A NORTH AND SOUTH POLE.

Boston, Nov. 2, 1896.

To the Electrical Age.

Dear Sirs:—In your valuable Inquiry column you offer to answer questions which subscribers chance to ask. Can you tell me why two magnetic poles attract each other? I know the law, that unlike poles have that strong tendency, but I do not know why. Kindly answer this question if it is not too abstract.

Yours, very respectfully,

Pierre Dulong.

(A.)—The physical explanation of this fact is beyond us. The attraction is due to the peculiar conditions in the ether which tend to draw the opposite poles together. In Flemings Dynamical Theory of Current Induction the explanation of Maxwell is given as follows:

"Any medium that can serve as a vehicle of magnetic force consists of a vast number of very small bodies called *cells*, capable of rotation . . . .

When magnetic force is transmitted by the medium or acts through it, these cells are supposed to be set in rotation with a velocity proportional to the intensity of the magnetic force . . . . all rotating around the lines of force as axes . . . .

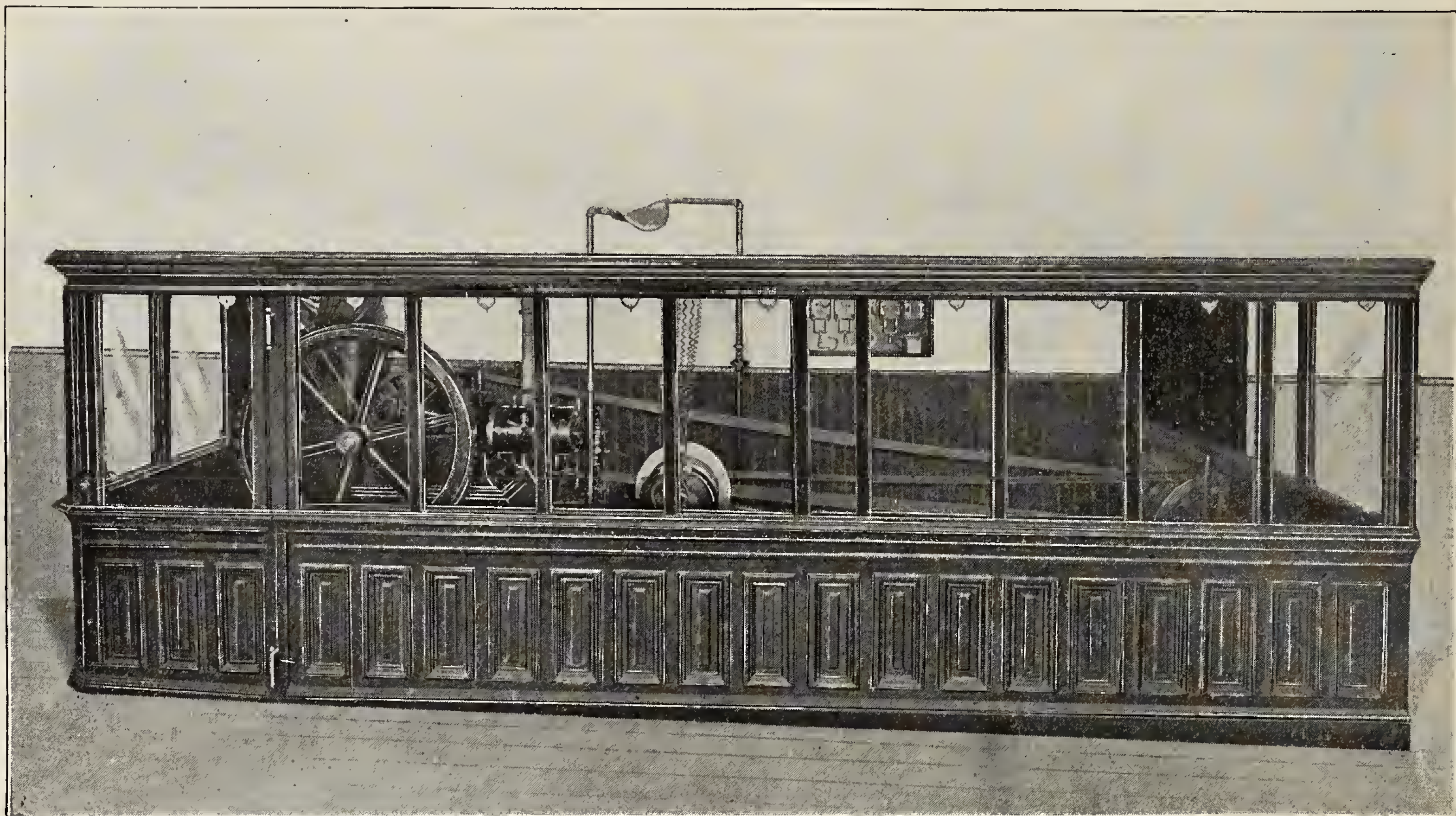
These cells as they revolve tend to flatten out . . . . they thus *contract* along the lines of force and expand at right angles, creating a *tension* along the lines of force and a *pressure* at right angles to them."

ELECTRIC LIGHTING BY GAS ENGINE.

The engraving shows a dynamo room for isolated electric light plants using a gas engine for power. The space occupied is very small. The principal features of these plants are:

First. Economy. Using gas at $1.25 per 1,000 feet, the cost per 16-c. p. lamp is about one-quarter of one cent an hour. If in the country where naphtha or gasoline can be used, the cost is about one-eighth of a cent per lamp. (These prices are guaranteed by the L. J. Wing & Co.)

Second. These plants require but little attention; do not require a licensed engineer, and any person of ordinary intelligence can run them. Looking after the proper lubrication once in a few hours is all that is needed; unlike a steam plant, where an engineer must be in constant



A Wing Gas Engine Electric Light Plant.

attendance.

Third. Safety.—The modern gas engine has the electric spark ignition, and has no fire or flame to give heat or possible danger, and therefore these plants are absolutely safe. There can be no explosion, as sometimes occurs in the very best of steam boilers.

Fourth. The flicker in the light or uneven voltage of the lamps have both been obviated by the use of Wing's equalizing device attached to the shaft or dynamo, and the light is now equal to that produced by the usual high speed steam-engine.

Fifth. These plants are peculiarly adapted for use in country houses and on farms, as the engine can be used for any other work, and are very valuable for pumping water and for protection against fire, as they can be started instantly and can be arranged to throw a stream of water equal to a good city fire-engine and thus save many a fine property from destruction.

Messrs. L. J. Wing & Company, 109 Liberty street, have made arrangements for equipping these plants complete, of any size from fifteen to five hundred lights. They have been in the machinery and electric business for many years and have the reputation of doing only the best of work.

(Q.)—GREATEST SPEED OF ELECTRIC RAILWAYS.

St. Louis, Nov. 8, '96.

Electrical Age.

Dear Sirs:—Living in a town that has some good electric roads in it, I made up my mind to ask through your valuable columns whether these cars can travel much quicker than they do, or whether the natural speed is limited? Also, what the greatest speed is that can be attained by electric cars?

(A.)—The speed of a car is limited by gears and its own weight. The motor turns about 1,000 revolutions per minute; the car axle revolves at about 300 revolutions per minute. Were the car axle and motor shaft one, the car would fly at the rate of 100 miles an hour or over; that is, the car axle would turn 1,000 times a minute; but a heavier motorwould have to be used.

THE LUXURY OF TRAVEL.

"The man who has never been West over the picturesque New York Central has a sensation in store for him that he cannot afford to forego. Nature has done almost as much for him in what he sees, as mechanical skill has done in placing him in a magnificent hotel on wheels, and whirling him toward his destination on the very wings of the wind."—*Hardware.*

The American Engine Co., of Bound Brook, are about to ship one of their new American-Ball engines to the Chinese Government, to be used in driving machinery for the coinage of silver.

STANDARDS OF LIGHT.

(Continued from Page 666.)

XIV.

THE ACETYLENE FLAME.

A preliminary report has already been made to the Institute on the use of the acteylene flame as a light standard.*

In France, Violle has given some attention to the standard, and has published a note concerning it.† The latter recommends the use of a flat flame, maintained at a pressure of 30 cm. of water, the gas being mixed with air drawn in at the base of the burner. The entire flame may be used as the light source, or it may be screened to any desired amount. Under former conditions a consumption of gas of 58 litres per hour is reported as furnishing a light twenty times that of illuminating gas in an ordinary burner. The distribution of luminous intensity in the spectrum of acetylene is found to coincide quite closely with that of platinum at the melting point.

XV.

INCANDESCENT OXIDES.

Concerning the sources of light which depend upon the incandescence of a glowing metallic oxide, a sufficient amount of work has been done to show that, as a class, they possess a property fatal to their use as light standards. This property may be illustrated by means of measurements made by a member of the Committee on Light Standards.‡

In these measurements the radiation from the glowing oxide of calcium, namely, from a cylinder of the Drummond light brought to incandescence by the action of the oxy-hydrogen flame, was tested by means of the thermopile and galvanometer. The intensity of radiation, as determined by means of the deflection, was measured as function of the time from the instant of ignition for a period of fifty minutes. Similar curves were taken for the radiation capable of passing through water cells, which were interposed between the thermopile and the cylinder.

From the results, shown graphically in Fig. 18, there is seen to be a rapid and continual falling off in intensity, which, in the case of the total radiation, amounts to 60 per cent. during the first twenty minutes after ignition. This continues, but with decreasing rapidity, throughout the remainder of the time. At the end of fifty minutes, the intensity of radiation in terms of the initial intensity is about 27 per cent. By plotting the ratio of the curve of total radiation to that of luminous radiation, we obtain the radiant efficiency of the lime light as a function of the time. Were this curve a horizontal line, the conclusion would be that the quality of this source remained a constant, although the amount of light which it sends forth diminishes. The curve which is given in Fig. 19 indicates, however, that the initial efficiency, which amounts to about 15 per cent., falls off in the course of fifty minutes to less than nine per cent. The former corresponds to the radiant efficiency of the magnesium light, a value which is in accordance with the character of the light emitted by the freshly ignited lime. The latter shows a degree of incandescence inferior to that of the ordinary arc light. This change is in complete corroboration of the results of earlier photometric tests of this source.§

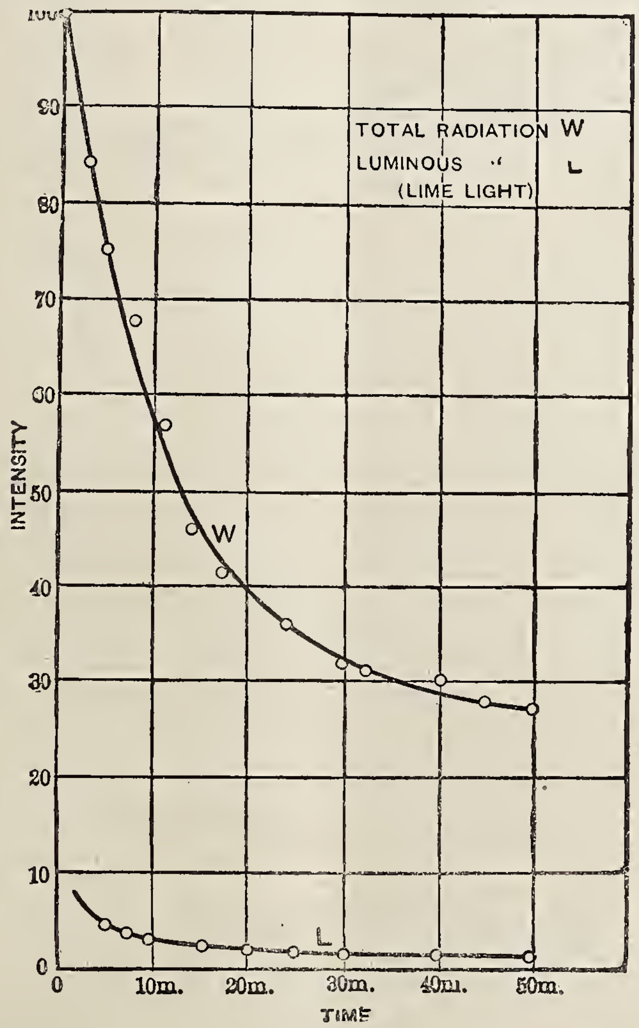


Fig. 18.

The measurements were supplemented by a photometric study of the lime light, in the course of which the decadence of three typical wave lengths was computed as a function of the time. These were violet, wave length 418, green wave length 535, and red wave length 662. Measurements of these regions of the spectrum during 30 minutes from the time of ignition, gave a curve the character of which is indicated in Fig. 20. It will be seen that in all three cases there is a very rapid diminution of light. The falling off of the value amounts to more than 80 per cent. during 30 minutes. From these values, and from a complete study of the spectrum of lime under the conditions which it reaches after 30 minutes, it is possible to plot curves showing the relative distribution of light in lime light and gas light at different times after ignition. In Fig. 21 a set of such curves are given, which show graphically the manner in which the lime light falls off in intensity and varies in quality during the first half hour

of its incandescence. These curves are very similar to those which have been obtained with oxide of zinc heated electrically to a temperature of 1,000.

Cursory observations, made in cases where disks of magnesium, oxide and zircon had been substituted for the lime, showed analogous behavior, although there seemed to be reason to believe that the decadence was not so rapid as in the case of lime.

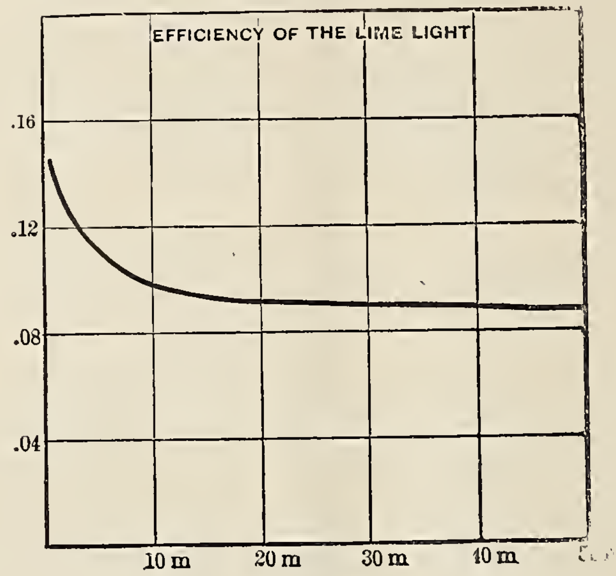


FIG. 19.

Measurements made with the Welsbach incandescent mantle burners afford abundant evidence of the same tendency on the part of this source of light. Records of

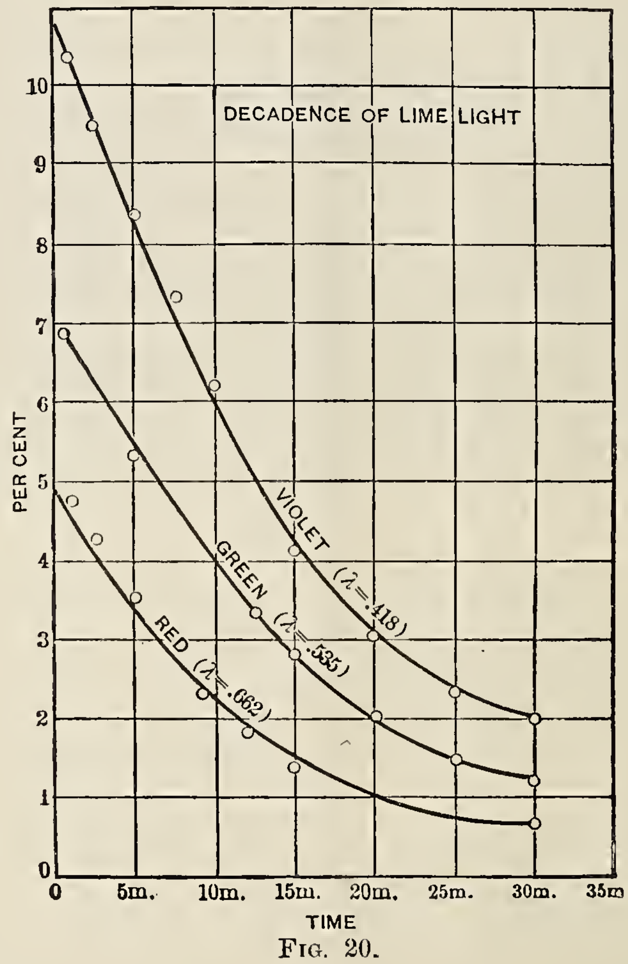


FIG. 20.

candle-power and gas supply have been made covering several hundred hours*.

(To be continued.)

*. Fessenden, Transactions, p. 507, June–July, 1895.
†. Comptes Rendus, Jan. 13, 1896.
‡. Nichols and Crehore, Phy. Rev., vol. i, p. 161.
§. See Pickering, "American Academy of Arts and Sciences," vol. xv; also Nichols and Franklin, American Journal of Science, vol. 38, p. 103.
‖. Franklin, Amer. Journal of Science, vol. xxxviii., pp. 401.
See Nichols and Snow, Philosophical Magazine, (5) vol. xxxii. pp. 401.
*. See thesis of E. V. Stebbins, Mss. in the Library of Cornell University, also Nicholas Laboratory Manual of Physics and Applied Electricity, vol. ii., p. 339.

TELEPHONES IN JAPAN.

Great activity is being shown in Japan to extend the telephone system throughout that country, and with the large sum which the Government have appropriated for that purpose there is reason to believe that a very complete system of telephony will be speedily completed and set to work. "Engineering" informs us that the people there seem everywhere eager to take advantage of this means of communication. In Tokio alone there are 2,000 subscribers, and more than 2,600 applicants are waiting impatiently to have the privilege extended to them also. The Japs seem to think that more is to be learned on this matter in the United States of America than anywhere else, for they have sent a commission of three experts to the States for the purpose of studying the latest developments. It is not very pleasant to find that in the far East we are no longer regarded as the pioneers in some departments of the applications of science. It is said that the camp telegraph apparatus purchased by the Japanese in Berlin had proved far better than that from France and England hitherto used in Japan, and that in future the Berlin material will be imported to Japan for the use of the Japanese army.

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CONTENTS.

EDITORIALS
- The Most Powerful Lighthouse in the World 683
- Niagara 683

GENERAL SUBJECTS
- Standards of Light 681
- Telephones in Japan 682
- Street Railway Trucks 684
- Magnetism and Magnetic Fields 685

TRADE ARTICLES
- Liquid Power 677
- Electric Gas Lighting by Gas Engine 680
- Chesley Electric Co. 690
- Automatic Switches for Electric Motors 691
- Imperishable Sounds 692
- Electric Stock Quotations 692

INQUIRY COLUMN 679

THE MOST POWERFUL LIGHTHOUSE IN THE WORLD.

In recent articles published in the "Electrical Age" mention has been made of the penetrating power of electric search lights. The enormous candle-power and scope of these lights, when constructed on a large scale, show the degree of perfection attained in the art. In the "Elmira News" the following clipping appears:

"The most powerful lighthouse in the world, now being built at Penmark Point, in the Department of Finistere, France, is more than half finished, and will be in working order, probably, at the end of next summer. The height of the tower is sixty-three meters, which will enable it to be seen during the day from a distance of thirty kilometers in fine weather. During the night its light will be visible for 100 kilometers. The rotundity of the globe will prevent the rays from striking the eye directly at a distance of more than fifty kilometers, but the sky overhead will be illuminated for fifty kilometers more. The great illuminating power of the light is provided by a similar apparatus to the first used in France in 1829, at the Heve lighthouse. The principle is based on the fact that a flash of lightning lasting no more than one-tenth of a second suffices to produce on the retina its complete effect. The new lighthouse will send flashes of concentrated light over the ocean every five seconds, each flash lasting one-tenth of a second. The St. Katharine's light, on the Isle of Wight, has an intensity of 600 Carcel lamps. The new lighthouse at Penmark Point, which is to be named after the Marshal Prince d'Eckmuhl, will be provided with a light of 36,000,000 Carcel lamps, or 36-000,000 candle-power; and that illuminating strength will, it is said, be obtained by means of electrical apparatus having but one-third of the intensity of those used at St. Katharine's lighthouse. The Penmark light will have cost, when completed, £24,000, the half of which is provided by the state, and the other half by a legacy from the Marchioness de Blocqueville, a daughter of Prince d'Eckmuhl."

For the benefit of our readers we state that the tower is about 200 feet high and the light at night will be visible over a radius of 80 miles; that is, cover a circle 160 miles in diameter, or an area of more than 20,000 square miles. The expenditure of $120,000 ought to produce some such result as this; the necessity for powerful signalling apparatus on every rocky approach or dangerous shoal has been long appreciated, and the comparative table of sea disasters shows a decided reduction in damage to life and property that can be traced not only to the more perfected mechanism in use but to the warning light erected at many points by the beneficence of friendly hearts.

NIAGARA.

Silently, without doubt or dread, a great artery of power was set into pulsing being, from Niagara to the city of Buffalo.

At midnight, when the sixteenth of November hastened to follow in the footsteps of its retreating predecessor, Secretary Rankine, of the Cataract Power and Conduit Co., closed the switch that sealed the union of Buffalo city and the mighty Falls. What would the Jesuit explorer, Father Rageneau, say if he saw the change that had occurred since his letter reached the Father Superior, in 1648, describing the grandeur of Niagara!

The genii of the Falls are now at work carrying a city in their hands. Since 1725 the commercial use of the Falls was kept in view, and in 1896, nearly two hundred years after the idea found issue, we see its final crystallization.

The Buffalo Express publishes the following resume establishing the steps of a memorable epoch:

First use of power (primitive sawmill)		1725
Augustus Porter conceives plan of extending hydraulic canals		1842
Peter Emslie's plans published		1847
Horace H. Day completes hydraulic canal		1861
10,000 horse-power developed		1885
Thomas M. Evershed called into consultation with capitalists		1885
Niagara Falls Power Company incorporated	March 31,	1886
Cataract Construction Company incorporated	February 10,	1889
Work begun on tunnel	October 5,	1890
Competitive plans invited for development of power and its transmission to Buffalo	December,	1891
Canal completed	October,	1892
Tunnel completed	January,	1893
Application to city of Buffalo for franchise	January 10,	1895
First dynamo started	April 5,	1895
Pittsburg Reduction Company (first application of power) began operations	August 26,	1895
Franchise granted by city of Buffalo	December 16,	1895
Franchise accepted by Power Company	January 14,	1896
Cataract Power and Conduit Company incorporated	July 17,	1896
Work on transmission line begun	August 14,	1896
Transmission line completed	November 15,	1896

Enterprise and grit have linked together the Falls and Buffalo in the face of many difficulties. Thousands of horse-power will traverse the line. We congratulate both engineers and capitalists on the success of their work.

STREET RAILWAY TRUCKS.

BY JOHN N. AKARMAN.

Now as a result of the best information and from large experience I believe the ideal four-wheeled truck for electric cars at the present time is one having the fewest number of parts in its construction, in which the side pieces of the main frame are single, forged bars, connected across the ends by bars either bolted or welded on so as to make the frame one continuous piece. This frame is carried by springs from the journal boxes, and itself carries an upper cord; likewise, a continuous, rectangular piece which has suitable seats for the springs. This upper cord is recessed to take the bolts and spring seats, and leaving its upper surface flush. The ends are carried by the half elliptic springs, while the spirals are placed at the journal boxes. The brake should be hung by links.

Diagonal bracing, on account of the motors, is out of the question in the construction of a truck, but the diagonal strength is usually increased by the introduction of transoms. Such a frame carries its machinery with a certainty of its always being in alignment with the driving axle; and, as it is spring carried, it is as light on the rails as any form of single truck, while the longitudinal oscillation is prevented by the peculiar effect of the half-elliptic springs, which do not respond readily to rhythmic motion. So much for the form of construction of a good type of four-wheeled trucks; but what of the disadvantages of four-wheeled trucks in general? Taken at its best, the four-wheeled truck is an uncomfortable carriage and a veritable track destroyer, and should only be used, according to the best judgment of many of our wide-awake railroad men, where cars are run at comparatively slow speed and with moderate length of car bodies. Where it is desirable to run at higher rate of speed, in suburban service, the damage to the track becomes so great that it should preclude its use. The increased length of wheel base made necessary, makes it hard on curves.

The only alternative is to use a double truck car with swivel or pivoted trucks. The advantage of this form of truck is very great, and while nearly everyone is familiar with its good qualities in a general way, I hope I may be pardoned for going into details which are not so well known. They are easy on curves to a degree that would hardly be credited by those who have only been familiar with four-wheeled cars. The greater number of wheels not only reduces the weight on each wheel, but correspondingly reduces the blow when the wheels strike a joint or a low place in the track. This is still further diminished by what is known as "equalization," which practically places the car body at the central point of the truck, so that each wheel in rising or falling, in passing over any imperfection in track, elevates the load a distance but half as great as its own rise.

Oscillation, whether longitudinal or transverse, can be completely done away with by the use of double tracks. While the trucks conform closely to all the irregularities of the line, the body can move forward with but very little influence from them. The conditions, however, are not altogether in favor of the pivotal truck. As, for instance, if all the weight is used for adhesion it is twice as expensive in use as a four-wheeled truck. If two motors are used, it only has 50 per cent. of the propelling power. In its ordinary form it makes a wide body necessary, and hence is out of place in narrow streets or places where traffic is very heavy. It also has the disadvantage of putting the body at a greater height than is necessary with four wheels.

But it meets a great many of the requirements for fast suburban service and has been endorsed with great satisfaction; but the objection which I have just mentioned precludes its use in many cases where it would have otherwise been desirable. Now the remedy for nearly all these objections has been found in what is known as the maximum traction truck.

The maximum traction truck may be defined as a pivotal truck in which the load is eccentrically placed in relation to the four wheels; two of them receive only a sufficient amount of weight to keep them upon the track, while the others take the remainder of the load. In practice it is found that 80 per cent. of the weight may be placed on the driving wheels, while 20 per cent. is used for guiding. Upon applying these trucks, it was found that it was not necessary to have the wheels of equal size; that a large pair of driving wheels and a small pair of idle wheels can be used. The large pair used as driving wheels, being very near the pivotal point, have a comparatively small amount of swing, and can be allowed to rise within the floor timbers, while the small wheels, moving through a much greater arc, easily clear the sills. By this form of construction the body cannot only be brought down, but the frame can be as narrow as in the ordinary street-car body. This form of truck enables the car to be utilized for both street and suburban service. It is also found in its latest form utilized under long, open cars. It carries the motors in a satisfactory manner, guides readily and answers nearly all the requirements of the service. But the question of what form of truck answers interurban service is one which every railway manager must study for himself. This becomes necessary because the conditions on different roads vary so much that there are scarcely two in the whole country upon which they are identical. The question of the amount of traffic and the headway which is required to run cars involves a careful study. With heavy traffic and frequent stops it is necessary to have low cars, from which ingress and egress are easy. An extra step will increase the danger to passengers very much. On the other hand, where passengers are carried a considerable distance without stops, long cars with more than one step are permissible.

An interurban service is almost equivalent to that of the steam roads; for this service pivotal trucks, having regular swing beams, equalizers, elliptic springs, and all the parts of the steam-road truck, are entirely satisfactory. They take curves easily at a high rate of speed. But for trucks which must run not only on trams, but on T rails, some form of the maximum-traction truck will give, all things considered, the best service.

In conclusion, let me call attention again to this very important question to be considered in connection with the adoption of single and double trucks, which is whether the punishment to the track by single trucks is not so great as to more than make up for the cost of putting in and running double trncks under cars of all lengths of bodies, whether short or long.

It is about time that some clever chemist took up the study of the effects of oil in steam boilers, and pronounced an authoritative judgment on the subject, for the differences of opinion expressed by engineers are most perplexing, and show how little the matter is understood. Some recommend its use in large quantities, while others condemn it altogether. We notice the Practical Engineer takes a medium course, and recommends only a very small quantity to be used in a boiler when clean, or with all rust removed, before filling up with water. About 1½ quarts of ordinary paraffin lamp oil are to be put into the empty boiler, and then the water admitted slowly and steadily, so that the thin film that rises with the surface of the water may coat the plates, and so form a protecting skin that will prevent corrosion. We are doubtful if the quantity stated is sufficient to form even a very thin film over the entire surface of a full-sized Lancashire boiler, and as this coating of oil can only cover the parts covered by water, the steam space would be left untouched. It has been our experience to hear more complaints of pitting in the steam space than in any other part of the boiler.

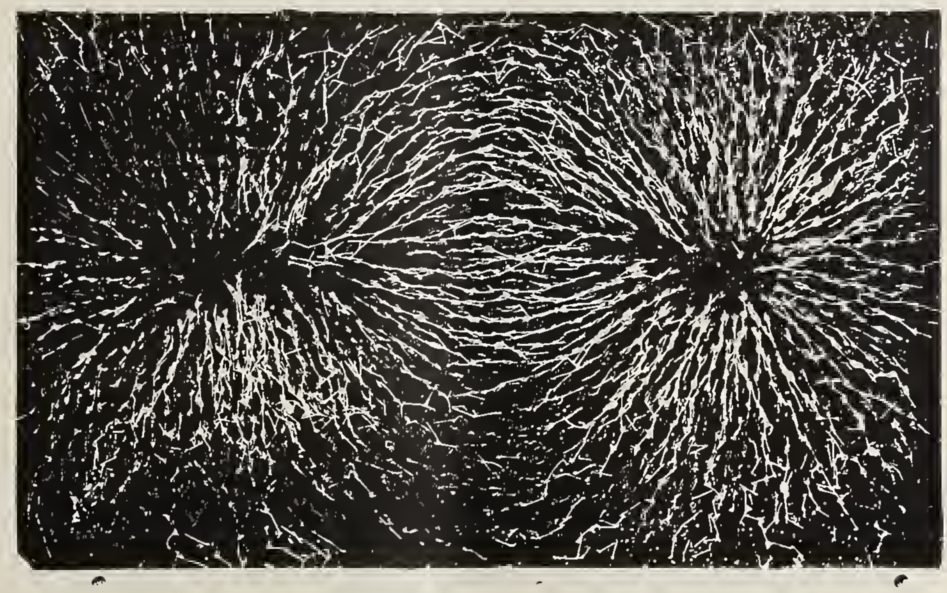
MAGNETISM AND MAGNETIC FIELDS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Magnetism is a natural phenomenon. The recognition of its remarkable effects dates back to the earliest ages of history. On the one hand the annals of Chinese lore contain fragmentary remarks pertaining to the lodestone; on the other hand, in the Arabian nights, a work of unknown age, we hear in the travels of Sinbad of the wonderful mountain that no ship could attempt to pass without destruction.

But there is no doubt that the mystery of the lodestone, like that of amber, gave rise to a host of interesting traditions.



Magnetic Field of Bar Magnet.

The Chinese, it seems, departed from the ancient marine practice of steering their vessels by the North Star as soon as they discovered the tendency of a magnet to point to the north. The use of the magnet or lodestone eventually became a familiar proceeding to the navigators of early days.

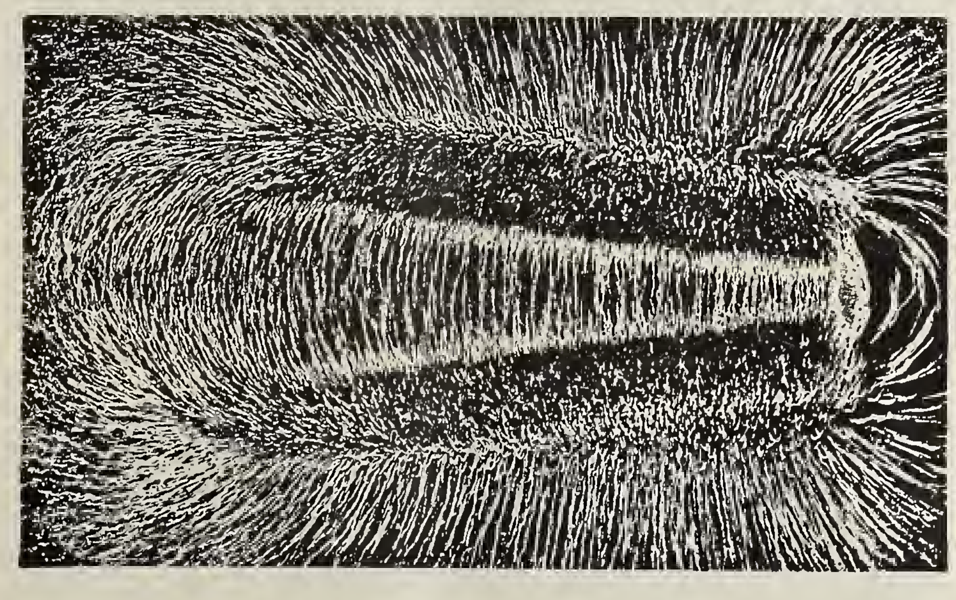
Poles.—Notice of its properties was made by so great a genius as Sir Isaac Newton, and because of the fact that the magnetic force was stronger at certain points of the lodestone than others, he called them poles.

Queen Elizabeth's reign marked the period in which science began to receive the proper attention, but it was necessarily harassed in its growth by the limited views of those who antagonized its progress. When the existence of poles became evident it was but a step to name them and examine into their properties.

North Pole.—It was decided to call the poles by names according to the position they took when the lodestone was suspended by a string. It was found by experiment that one end of the lodestone persisted in pointing *northward*, so the name north pole or *north-seeking pole* was given to it.

South Pole.—The other pole might just as well be considered as one always pointing *southward*, and it was considered just as appropriate to call it the south pole or *south-seeking pole.*

The magnetic force showed a tendency to discriminate between either one end of the earth or the other. It was but a step from this to experiment with magnetized bodies and show a very peculiar principle whose action was thus manifested.



Magnetic Field of Horseshoe Magnet.

Transmission of Magnetism.—It was discovered, whether by accident or intention it is difficult to say, that a piece of steel or iron could *apparently absorb* some of the magnetic qualities of the lodestone and possess in like manner all of its characteristics. It would then become

Magnetized,
Possess two poles,
Point North and South.

In other words, it was possible to *impart* magnetic qualities to steel or iron without in any way *diminishing* the original power of the lodestone.

Permanent Magnets.—When hard steel was thus rubbed with lodestone, the magnetism it received would not leave it except by

Hard and repeated blows,
A red heat,
An opposing magnetic force.

It was therefore decided to call such magnets permanent magnets.

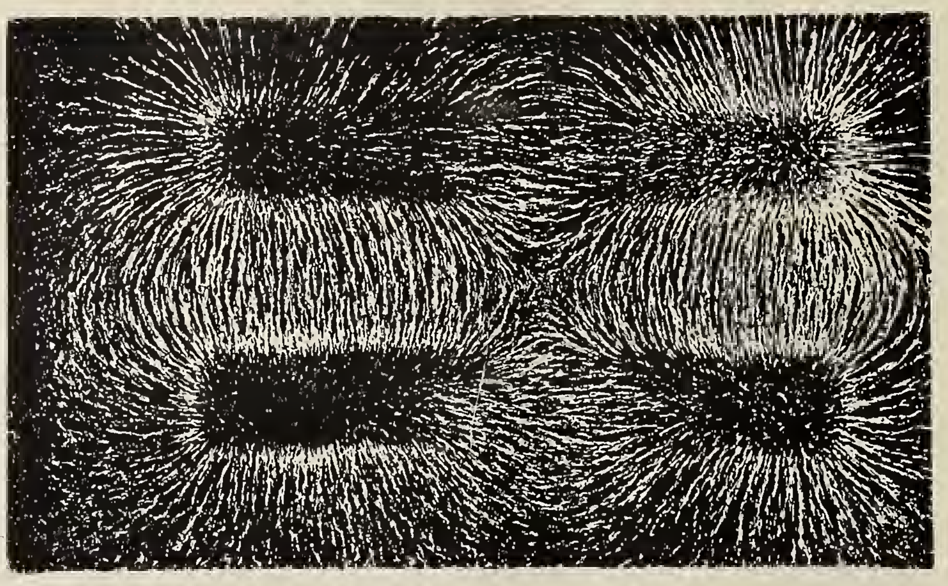
Temporary Magnets.—Soft iron or nickel was tried in the same manner, with the result that the magnetic force remained only as long as the lodestone was present and in near or intimate proximity. The magnetism was temporarily present, the iron being therefore called for the time being a *temporary magnet.*

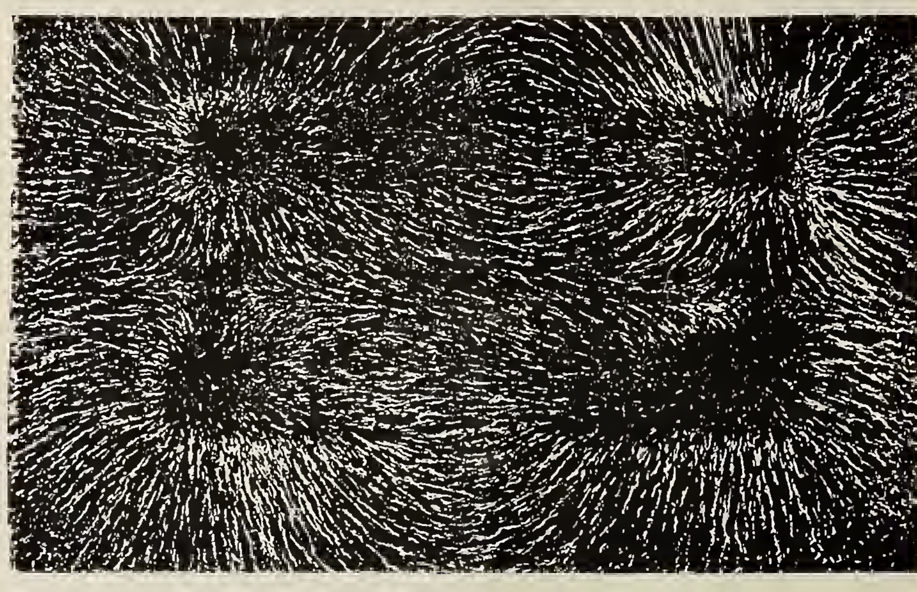
Law of Attraction.—The earth, as previously mentioned, always tried to make one end of a magnetized body point north. It was likewise found that with two magnetized bodies, one end of each unfailingly exhibits attraction for the other.

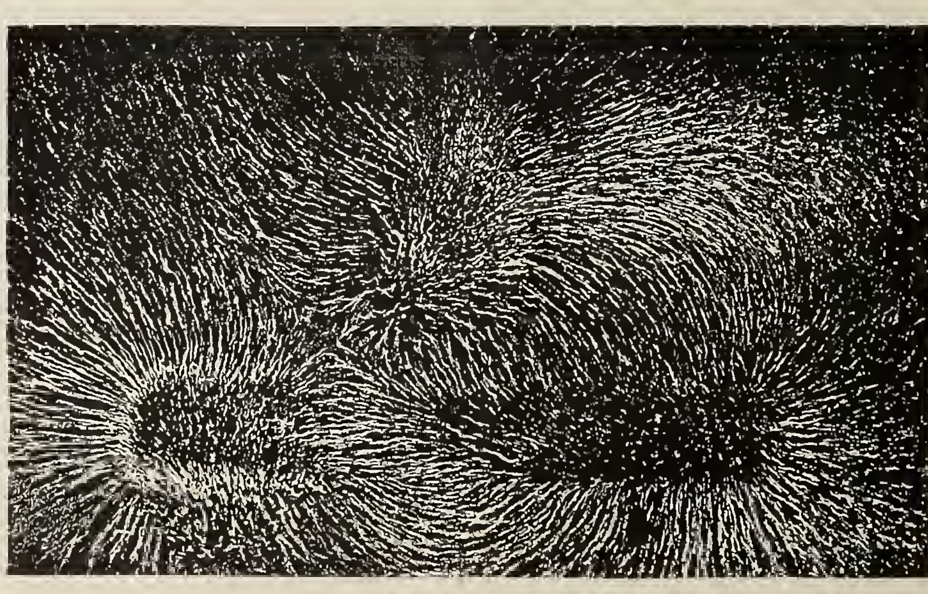
Law of Repulsion.—On the other hand the magnets individually could be made to repel each other. Two north seeking poles or two south seeking poles would mutually repel each other, but a north seeking and a south seeking pole constantly maintained a tendency to meet. We then have—

Two north poles repel,
Two south poles repel,
A north and south pole attract.

The laws of attraction and repulsion of magnetic poles are—


Attraction Between Unlike Poles of Two Bar Magnets.


Repulsion Between Like Poles of Two Bar Magnets.


Magnetic Field of a Bar Magnet and the End of Another Magnet.—Showing Attraction and Repulsion.

Like poles repel each other.
Unlike poles attract each other.

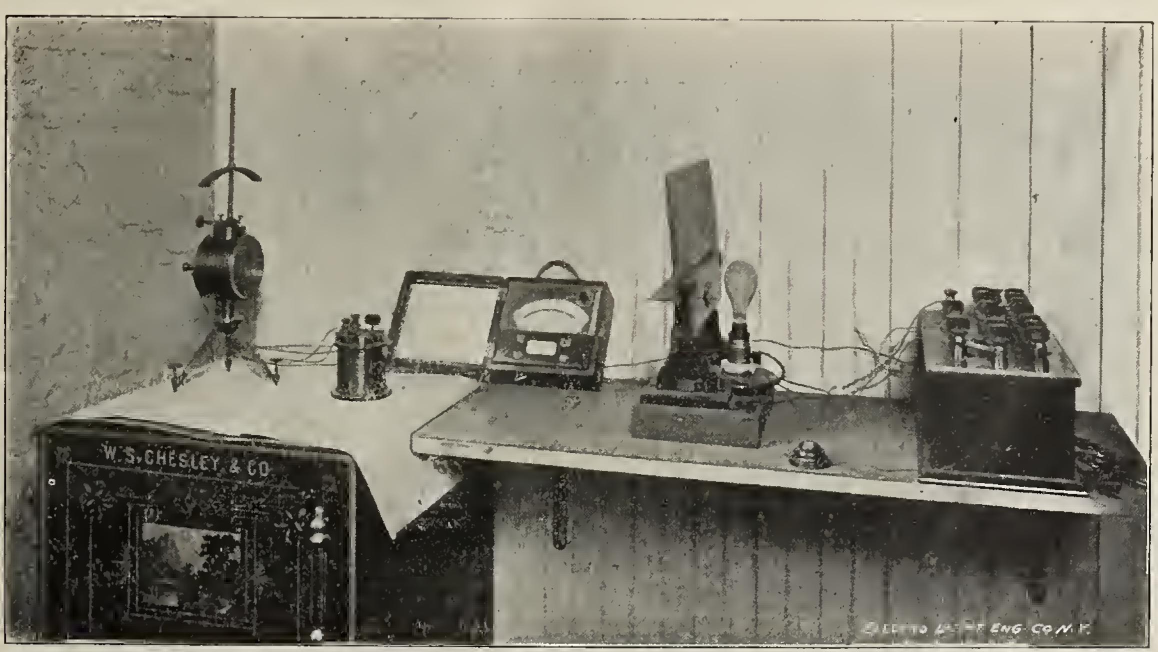
A Magnetic Field.—The space around a magnetized body is called a magnetic field. The presence of this

Armature of Street Railway Motor—See page 690.

field may be *perceived* by holding a piece of iron in the neighborhood of a strong magnet. The pull upon the

The Office—See page 690.

iron will illustrate the force thus exercising its functions as magnetic energy.



Thompson Reflecting Galvanometer and Wheatstone Bridge—See page 690.

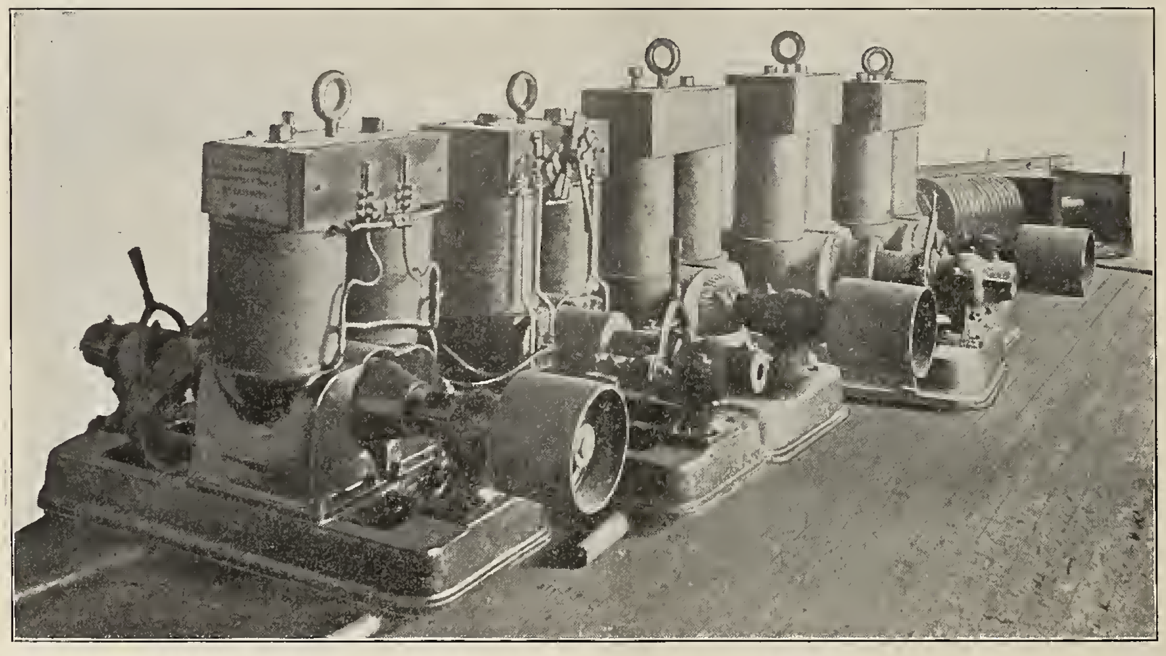
It is possible to increase this pull to 200 pounds a square inch. In order to do so, however, the *intensity* of the *field* must be increased. More magnetism must be produced. The best way of obtaining a stronger field is to employ the electric current by sending it through coils of wire surrounding a horseshoe of soft iron.

Lines of Force.—If upon a bar magnet a sheet of white paper is placed and *iron filings* are sifted over it, curious curves show themselves in the filings. They extend from one end of the magnet to the other in *continuous* lines. They appear broken and scattered at each extremity, but nevertheless they are complete from end to end in curves

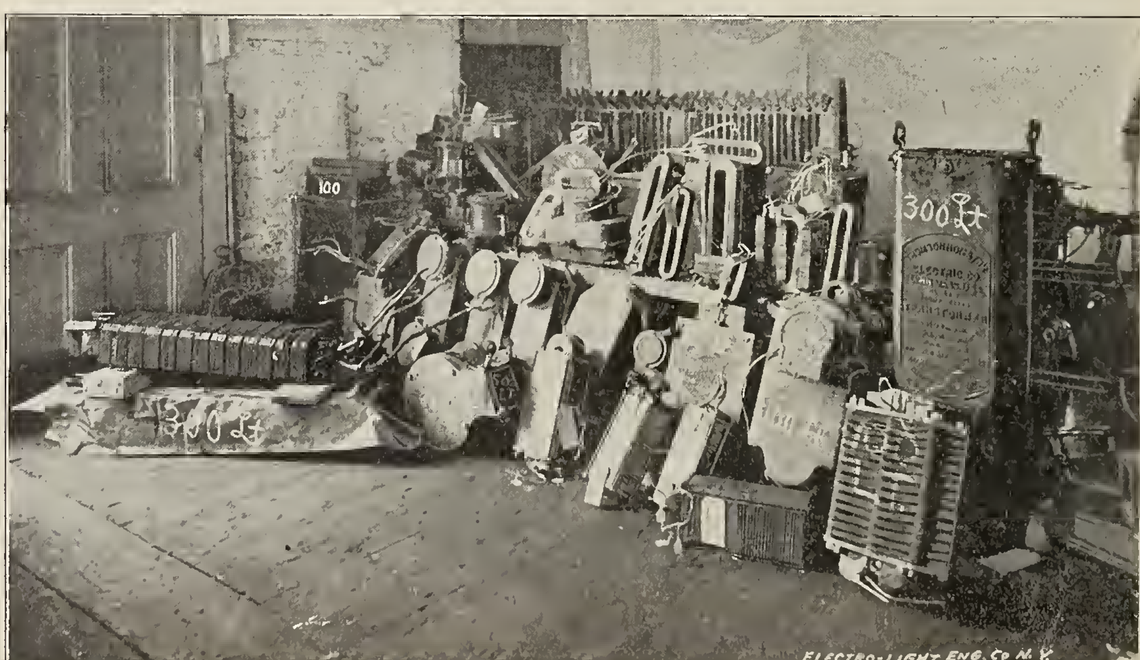
of increasing size. They illustrate the manner in which the magnetic force spreads from pole to pole, and the *attraction* that the lines of force of one pole have for those of the other. The streams of magnetic energy are called *lines of force*. Although the methods we use in our calculations cause us to look upon them in a more abstract manner, it may be remembered that a magnetic field consists of *physical* lines of force and depends for its effectiveness upon the strength of its field.

A magnet placed in a magnetic field will point in a direction parallel to the lines of force. If a magnetic needle is placed between the widely separated poles of a

Material Room—See page 690.



Group of Edison Dynamos Being Reconstructed for the American Sugar Refining Co.—See page 690.



A Group of Converters—See page 690.

magnet, its north pole will lie nearest to the magnets south.

A piece of iron is always in this condition; its particles, however, being irregularly arranged. When the iron is

Machine Shop.

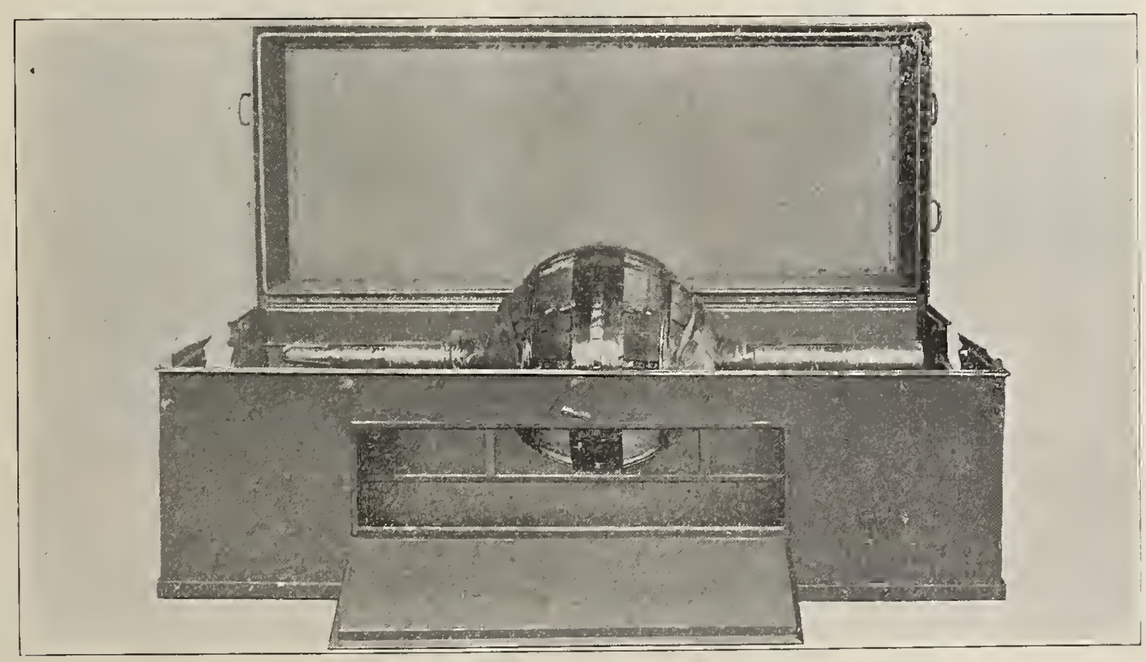
What a Magnet Consists Of.—It is supposed, and borne out by experiment, that a magnetic body consists of an

magnetized the particles form strings of little magnets, north pole touching south pole; with the removal of the

Armature Winding Room.

infinite number of small magnetized particles, with their opposite poles in contact. It is not necessary for the

magnetic force the particles fly back to their irregular grouping, and the poles at each end disappear. A knitting



One of the Drying Ovens Showing Armature in Position.

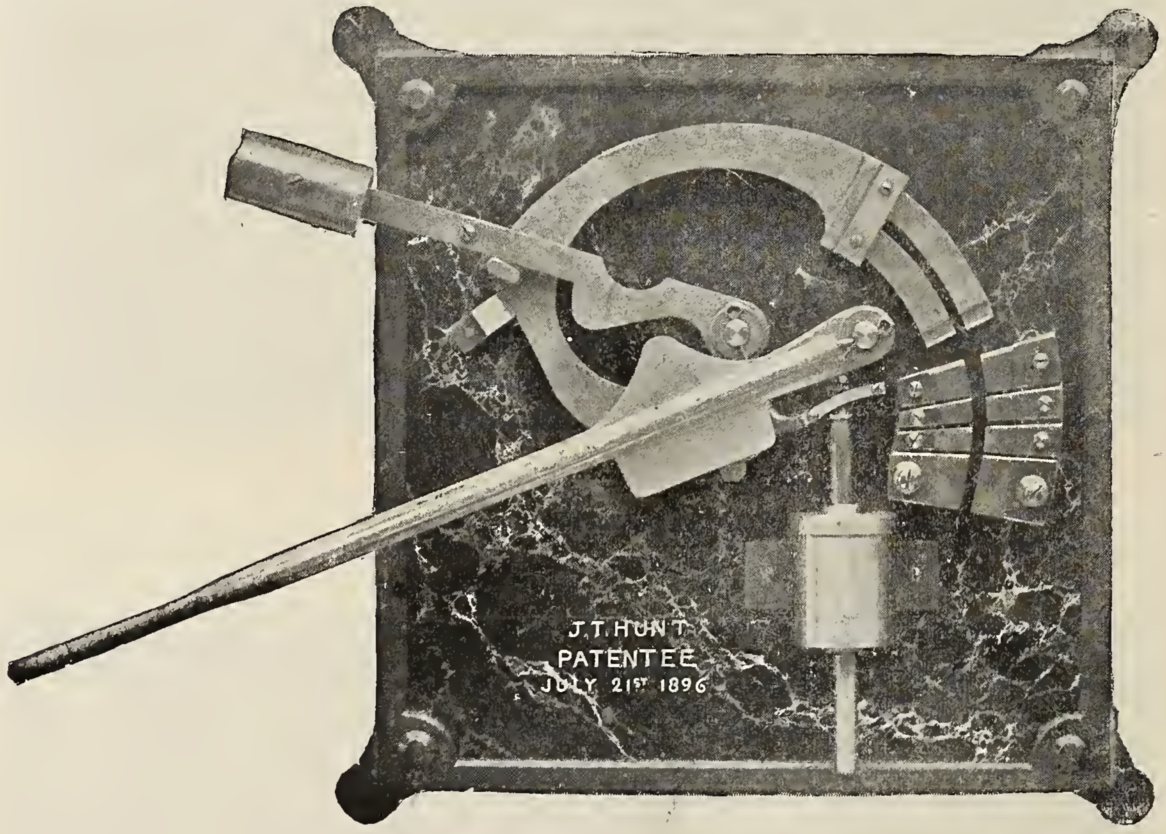
body to be *magnetized* to be in this condition, but to be merely susceptible to the influence of magnetic force.

needle magnetized may be broken into the smallest possible particles, and each will possess a north and south pole.

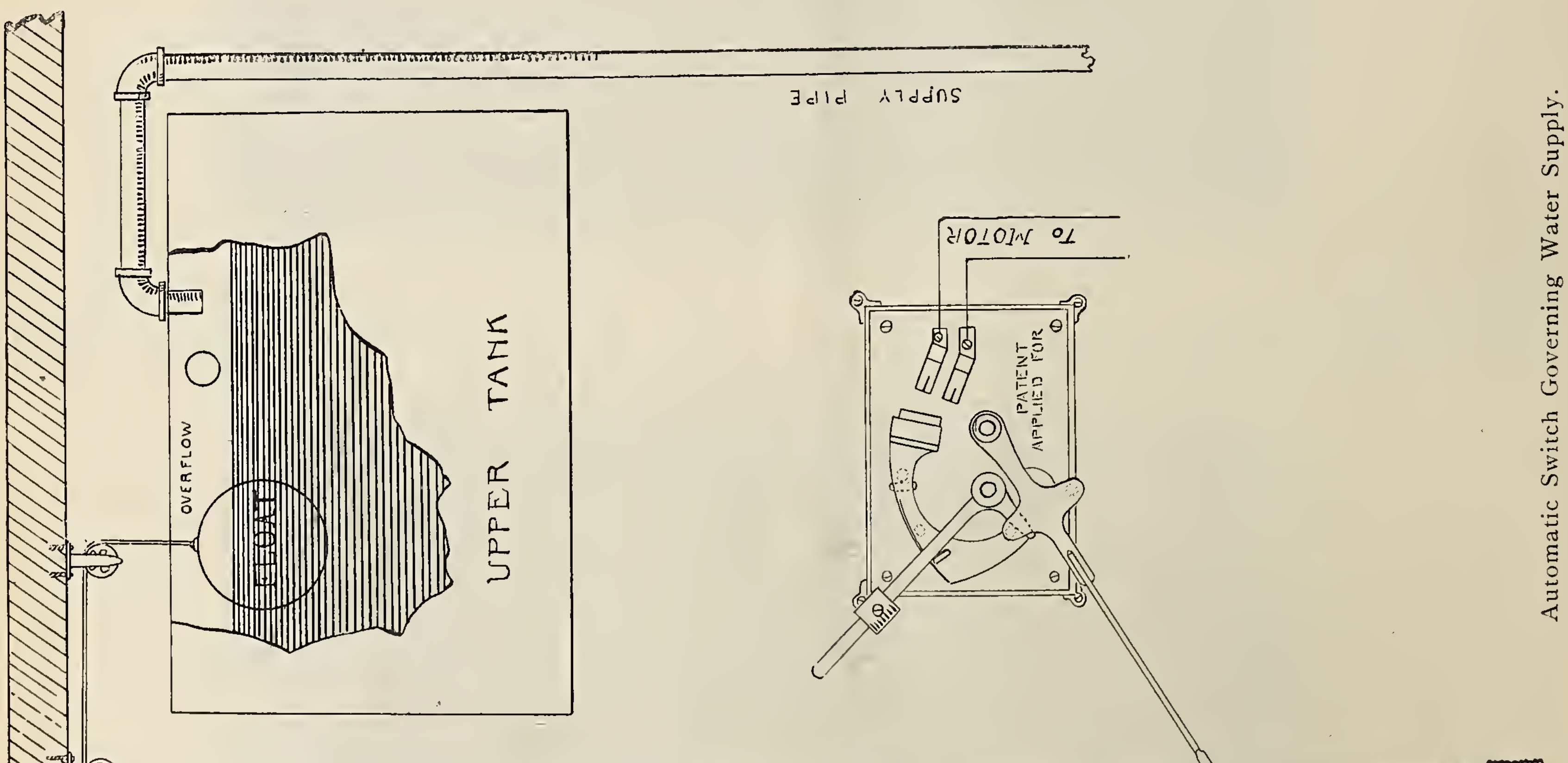
THE CHESLEY ELECTRIC COMPANY.

The Chesley Electric Co., of Hoboken, N. J., was organized by Mr. W. S. Chesley about five years ago. Mr. Chesley, since 1876, has had an extensive electrical experience in practical work. He has engaged in all the varied branches of the electrical profession. His business increased to such an extent that about five years ago he felt compelled to move to more commodious quarters. The premises they occupy at present admit the light with freedom on every side: this enables the workmen to dispense altogether with artificial light during the day. It is almost unnecessary to state that this is a great advantage when first-class work is desired. The different departments in which the various classes of work are done are contained in a one-story building nearly one hundred feet square. It can be quickly recognized by its business-like air, the stretch of ground it covers and by the sign painted upon its front, "Chesley Electric Co." The Chesley Electric Co. make a speciality of rebuilding or repairing heavy electrical machinery, and are open day and night; in fact, they never close. On the left of the building is the office. It contains a complete outfit for testing dynamos, motors, armatures, etc., after they have been repaired.

The stock or material room, likewise shown in sketch, always contains two reels of every size of insulated wire used in the shop, in addition to the tools and other necessities. The view of the machine shop, as shown, contains all the heavier machines needed in this work. When the writer called they were busy straightening a large shaft, this being one of the particular features of their work. The factory is run by a steam plant, but this is not its sole dependant, as they are prepared at a minute's notice to throw on a large electric motor feeding from the street railway circuit. An elaborate switchboard contains switches and meters for direct and alternating current, which can be taken respectively from the street circuits



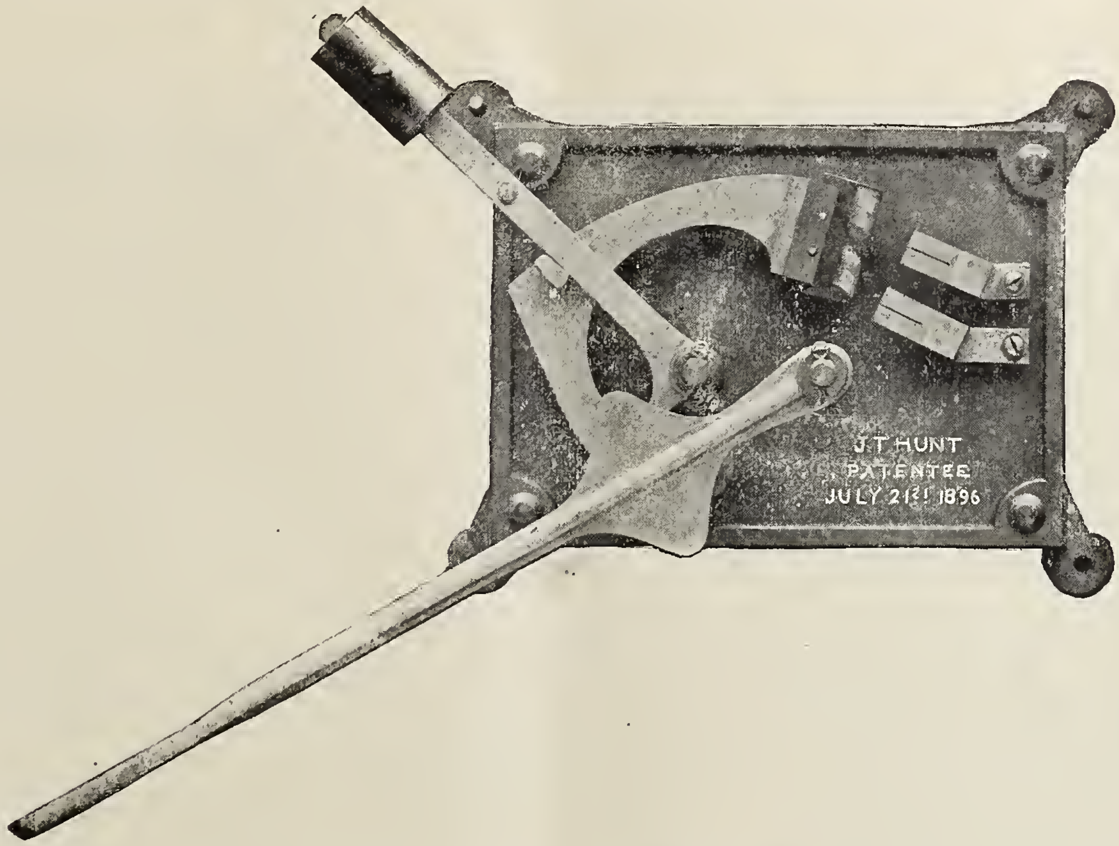
Automatic Switch for Shunt Motors.



Automatic Switch Governing Water Supply.

or generated by dynamos on the premises. This switchboard is used for testing; especially the one thousand-volt alternating current at the main switch. Step-up transformers are used for a higher voltage, or *vice-versa*. The illustration showing a group of converters gives a fair idea of the stock requiring repair continually on hand.

successfully complete anything in the line of apparatus needing reconstruction. They also make a specialty of buying and selling second-hand apparatus. Their works are convenient to the Barclay and Christopher street ferries; they also have an office in the Havemeyer Building, New York City.



Automatic Switch for Series Motors.

The armature winding room, as seen by the writer, was a scene of bustle and activity. Every style of armature was being rewound or otherwise repaired. A row of Edison dynamos are shown in another sketch. They give a fair idea of the appearance of the works during busy periods. The writer saw a large standard arc light armature, recently repaired, suspended in a tank. Mr. Chesley explained that this was their new process of varnishing armatures.

The insulating varnish they use in this manner is guaranteed to be superior to shellac; in fact, they prove that shellac is hygroscopic and materials coated with it are not impervious to moisture. On the other hand, their insulating varnish permeates the covering of the wire on


The Gramophone in Operation.

either armature or field, and makes it positively non-absorbent or hygroscopic in the slightest sense. They use a specially oiled muslin between the coils of arc armatures that will withstand a break-down test of 2,000 volts. In another sketch we show the driving oven, by whose aid armatures are entirely rid of all volatile material and thus receive the finishing touch. The company's good work in the past has given every evidence of their ability to

AUTOMATIC SWITCHES FOR ELECTRIC MOTORS.

The secret of building a successful automatic device seems to reside in the fact that it does not need an attendant. The majority of automatic appliances fail because they are not automatic; that is, they require constant watching and attention. The well-known electrical engineers and contractors, Zimdars & Hunt, of 127 Fifth avenue, N. Y., manufacture automatic switches which are particularly good for electrically driven pumps or cases in which a limited supply of water is to be delivered and retained constant in volume. In one cut we show a switch when open. A weight attached to a lever rests upon a projecting piece of metal belonging to an arm working the tongue of the switch. The lower level will, by an upward throw, force the weight forward and allow the tongue to find its place between the cheeks of the switch. The broader portion of the lower lever contains on each side two metallic projections which respectively catch the upper weighted arm and throw it either forward or backward. The line cut thoroughly

illustrates this principle, showing tank and switch in their relative positions. As seen in this case the tank is practically full; the floating metal ball has allowed the weight to descend and thrown the lower lever down, thus causing the upper weighted lever to open the switch. The depth of water in the tank can be kept at any point by reducing the distance between the adjusting balls, seen on the chain suspending the weight. One style of switch starts and stops series motors automatically. It is made for machines that do not exceed one-half horse-power in size. Their switches are of two styles, plain slate base in iron frame, unfinished metal parts on marbleized slate; japanned iron frame and polished metal parts. They supply in addition a copper ball float, brass chain weight and adjusting balls. In the other illustration we represent an automatic switch used in connection with a shunt motor, having a graduated resistance and automatic break switch. This switch is remarkable on account of its fine adjustment, as it is possible to regulate it so that from five to thirty seconds are taken at the user's option to turn on the full current. The starting-box appliance prevents sparking and eliminates all danger from a sudden rush of current. They are made in sizes of from one to five horse-power, inclusive; of two grades, finished either plainly or with polished metal parts and marbleized slate. In the last switch mentioned it may be noticed that the time interval is secured in switching the motor on, by using an air-cushion or dash-pot. A great many firms have been using these switches with satisfaction for over five months; concerns like the equitable Gas Works, 40th street and East River; the Cook Apartment House, 117th street and St. Nicholas avenue; the electric light plant at 45–49 Bleecker street; Hotel Logeret, 18th street and Fifth avenue; Charles Yandell, decorator, 18th street and Fifth avenue; the home of James C. Pyle, Fifty-third street and Fifth avenue; and the Carollton, at 76th street and Madison avenue, having under control a five horse-power Eddy motor. In Brooklyn, the Pearl street station of the Brooklyn Edison Company have one in use; likewise Mr. Peabody, a representative of the company, has one at his home. In connection with his new electric pump work, Mr. W. E. Quimby makes almost exclusive use of these switches. There is every evidence that their use will become general, as they speak well for the inventive and practical mind of Mr. J. T. Hunt. They have proven indispensable in many cases and fill at present a long-felt want in the market.

IMPERISHABLE SOUNDS.

An excellent talking machine, of very low price, has been put upon the market by the National Gramophone Co., of 874 Broadway, N. Y. It consists essentially of a revolving metal plate upon which rests a needle-point connecting with a diaphragm. A plate upon which a record has been taken will be filled with a spiral of wavy lines very close together and having within their compass a range of sound that is truly marvellous. The metal plate containing a "sound record" will last for years without destruction; and it is merely necessary in order to reproduce the sound to insert it in the "gramophone," allow the needle to start in the beginning of the spiral, and follow it through to the end. The little needle is caused to vibrate, due to the minute but systematic irregularities of this spiral groove. The vibrations are transmitted to a diaphragm connecting to the needle, and the pure melody, voice or sound, issues with remarkable purity and excellence. In the accompanying illustration we show the method by which a party can enjoy the novel pleasure of listening to this machine-giving utterance. A set of one hundred needles is supplied with it and two imperishable records. Some of their plates contain lifelike reproductions of rural sounds, of the farm with its crowing roosters, lowing cattle and eloquent calves. The National Gramophone Co. sell their outfit complete for the sum of $10.00; the fund of amusement supplied by so interesting a device seems inexhaustible, and those who have indulged in this small luxury contemplate their purchase with deep satisfaction.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
Edison Elec. Illg. Co., New York,	101	102
Edison Elec. Illg. Co., Brooklyn,	99	100
Edison Ore Milling Co.,	9½	—
Edison Elec. Storage Company,	27¾	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co. T. Sec. Series A,	2½	4
General Electric Company,	32½	33½
General Electric Company pf.,	70	75
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	80	81½
Rhode Island Elec. Protec. Co.,	—	122
Royal Elec. Co. (Canada),	105	115
Toronto (Canada) Elec. Light Co.,	—	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse Elec. & Mfg. Co.,	26	26
Westinghouse El. & Mfg. Co., pf.,	50	51
Westinghouse El. & Mfg. Co., assd.,	—	28

*Ex dividend.

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The Step-Down Transformers at Buffalo.

ELECTRIC POWER FROM NIAGARA TO BUFFALO.

The 16th of November, 1896, marks an epoch in the history of Buffalo and one in which the whole manufacturing aspect of that busy city within a short time may be metamorphosed. One minute after midnight, with the closing of five sets of switches, the power from the cataract at Niagara was brought into the city of Buffalo.

The history of the generating station of the Niagara Falls Power Company is already so well known to our readers that we will not refer to it except to say that the three great two-phase generators are all in use furnishing power to the factories in and immediately around Niagara. The most recent addition to the power-house equipment is one of the General Electric Company's converters, to take the two-phase current from the generators at 2,200 volts and turn direct current into the lines of two or three railroad companies at a pressure of from 575 volts to 600 volts.

When the question of the transmission of power from Niagara to Buffalo was under discussion, the merits of the three-phase system as compared with the two-phase system for transmission purposes were canvassed. It was shown to the satisfaction of the Power Company that, in using the three-phase system for transmission, a large economy could be made in the transmission installation, and the three-phase system of the General Electric Company was selected.

The current from the Falls is generated by the Niagara Falls Power Company, which transmits the power as far as the city limits of Buffalo. All the construction work in connection with this installation was effected by the Cataract Construction Company, while the distribution, after it has reached the city limits, is in the hands of a sub-company entitled "The Cataract Power & Conduit Company."

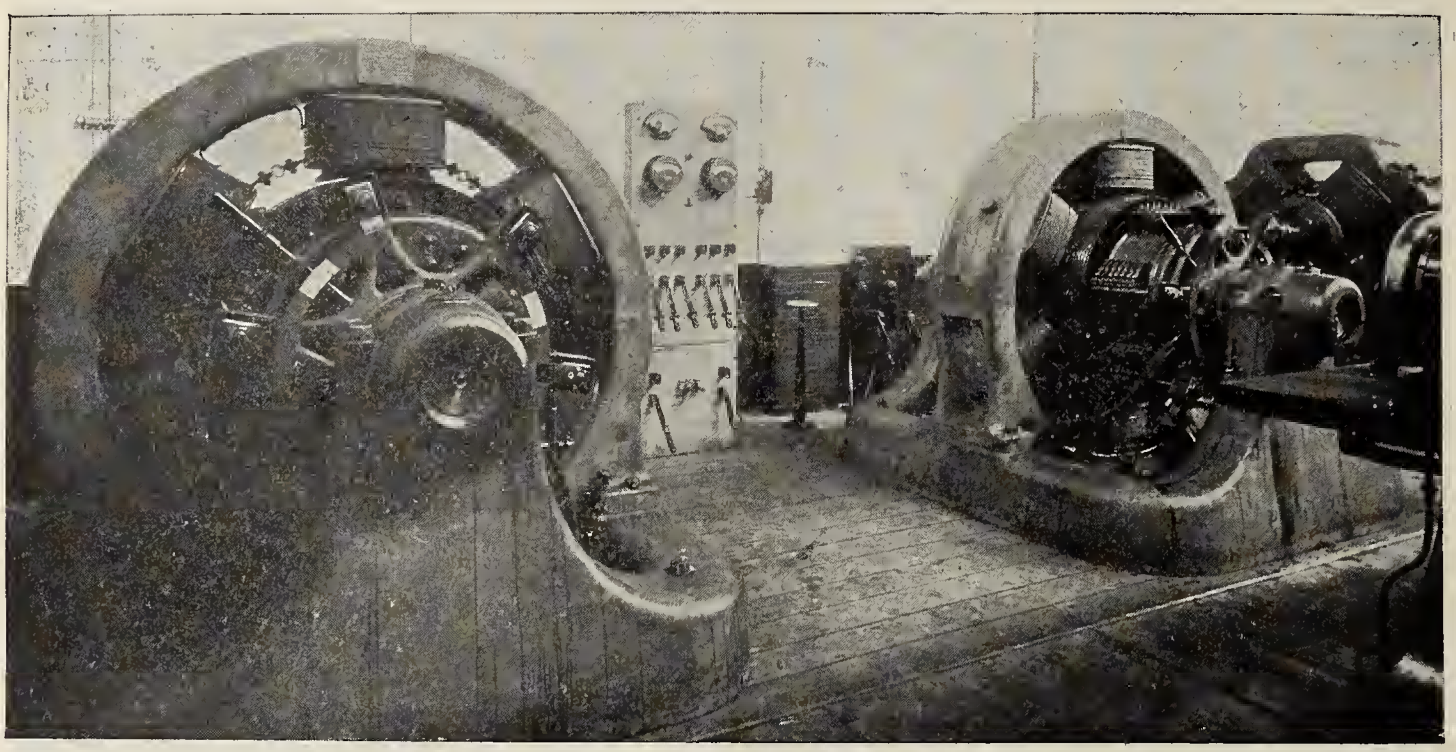
The two-phase current starting from the generators in the power-house is led first to the switchboard and then in lead-covered cables through the covered "Bridge of Sighs," which passes over the canal of the Niagara Falls Power Company to a spacious transformer house that has been erected on the opposite side of the canal. Here the cables are connected to four switches on a blue marble switchboard. From this board they pass to the step-up transformers, the largest in the world, erected on a platform at one end of the power-house and placed over an air-tight chamber. Each has a capacity of 935 K.W., or 1250 H.-P., and stands 94 inches high on a base 54 inches by 56 inches, and weighs 25,000 pounds.

The problem of cooling these transformers has been solved by driving a blast of cold air up through the air passages provided in the core and coils. The blast is furnished by a large blower driven by a 5-H. P., multipolar motor which is belted to it. It is in these transform-

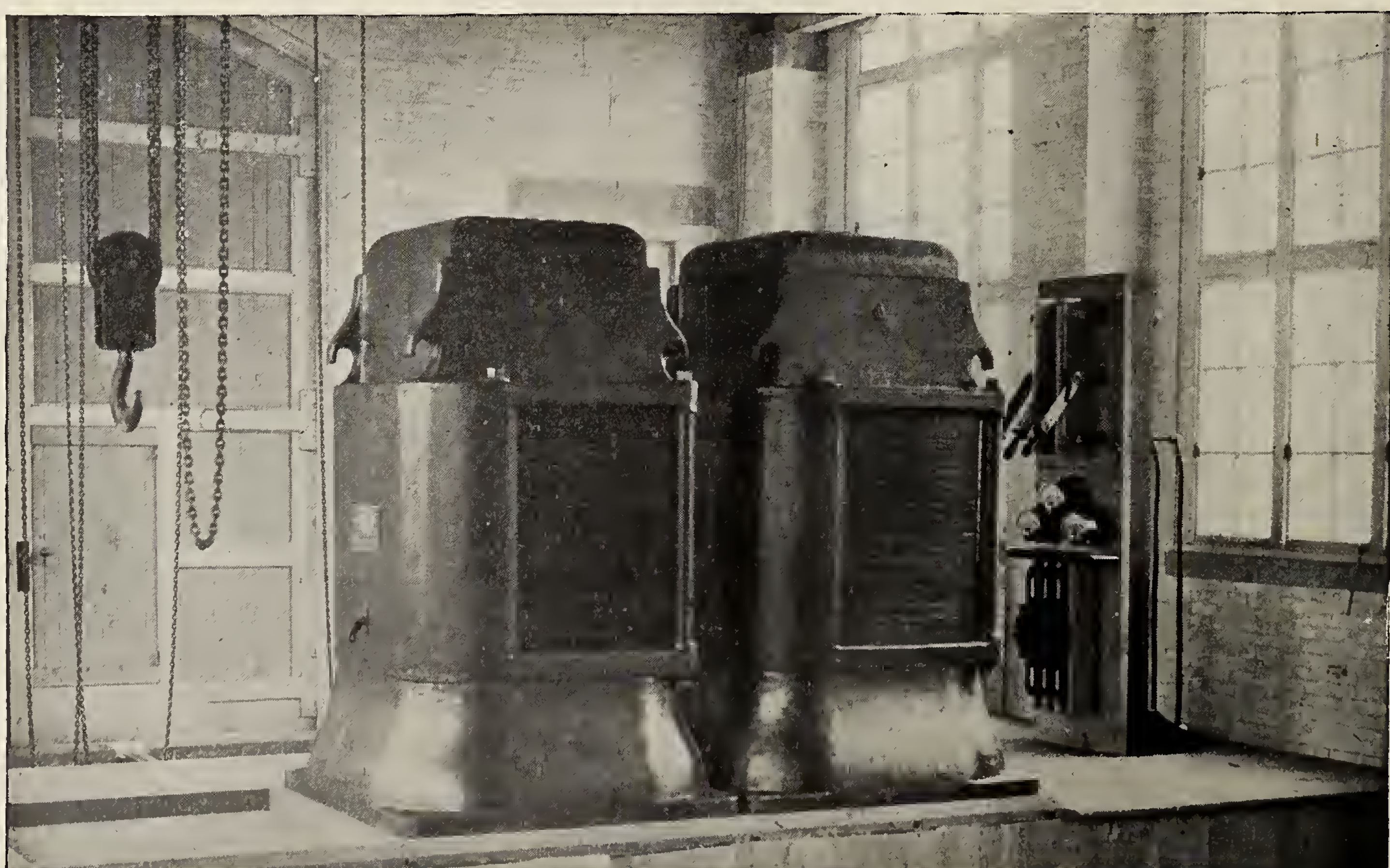
ers that the two-phase system is abandoned and the current given three phases, and raised from 2,200 volts alternating to 11,000 volts. Provision is also made in these transformers for raising the voltage to 22,000 volts, as soon as higher pressure shall have become necessary.

From the transformers three cables pass to the high tension switchboard standing beside them. This switchboard is also of marble and carries three high tension switches, each switch being separated by a marble barrier about one inch thick. This partition prevents arcing from switch to switch at the high pressure used. The switchboard also carries current indicators and three special fuse carriers. From the transformer house the wires pass through lightning arresters to the first pole of the pole line standing immediately in the rear of the building.

The pole line erected by White, Crosby & Co., runs along one side of a special right of way 30 feet wide. The number of poles in this line is about 21,000; they range from 35 to 65 feet in length and are set about 75 feet apart. Each pole is provided with two 12-foot cross-arms for the transmission line, and one small cross-arm for a telephone line. Each side of each cross-arm has space for three pins to carry three insulators, provision being thus made for four circuits of three wires apiece; the capacity of each circuit bieng 5,000 H. P. at 11,000 volts pressure, and 10,000 H. P. at 22,000 volts pressure. On the outside of each upper cross-arm is a small iron pin, 18 inches high, which serves to carry a galvanized barbed wire used as a lightning conductor and connected to the ground at the foot of every fifth pole.



The Rotary Converters at Buffalo.



The 1250 H.-P. Step-Up Transformers at Buffalo.

The insulators used are of the double petticoat pattern. Each weighs about twelve pounds and is provided with two annular grooves in the bottom, which effectually pre-

vent any moisture getting to the central pin on which the insulator is placed. The outside of the insulator is provided with a gutter running to a point on each side to carry off the water. These insulators were subjected to a rigid test of 40,000 volts alternating, to determine the electrical resistance, and not until they had withstood this pressure satisfactorily were they accepted.

The length of the line is twenty-six miles. The overhead conductors are of bare, stranded copper, each conductor having a diameter of 350,000 circular mils, and each lies in a groove at the apex of the insulators. When the line approaches the station at Buffalo, which it does along the banks of the Erie Canal, it is changed from overhead to underground, the wires passing from the last pole into a small brick terminal house. In this house connections are made with the underground cables through lightning arresters to the transformers, of which there are three, two being in use and the third being held in reserve. Each weighs 7,000 pounds, is 82 inches high, with a base measurement of 47 inches by 36 inches. In the step-down transformers the pressure is reduced from 10,700 volts to 370.

A system of coiling the transformers, similar to that used with the step-up transformers at the Niagara end, is used.

From the step-down transformers the three-phase current, divided into two circuits, passes over six cables to the main floor of the power-house of the Buffalo Railway Company, where they are connected to another switchboard. Thence they pass to the two rotary converters, each of 500 H. P. capacity. These converters are six-pole machines, and in their operation the three-phase alternat-

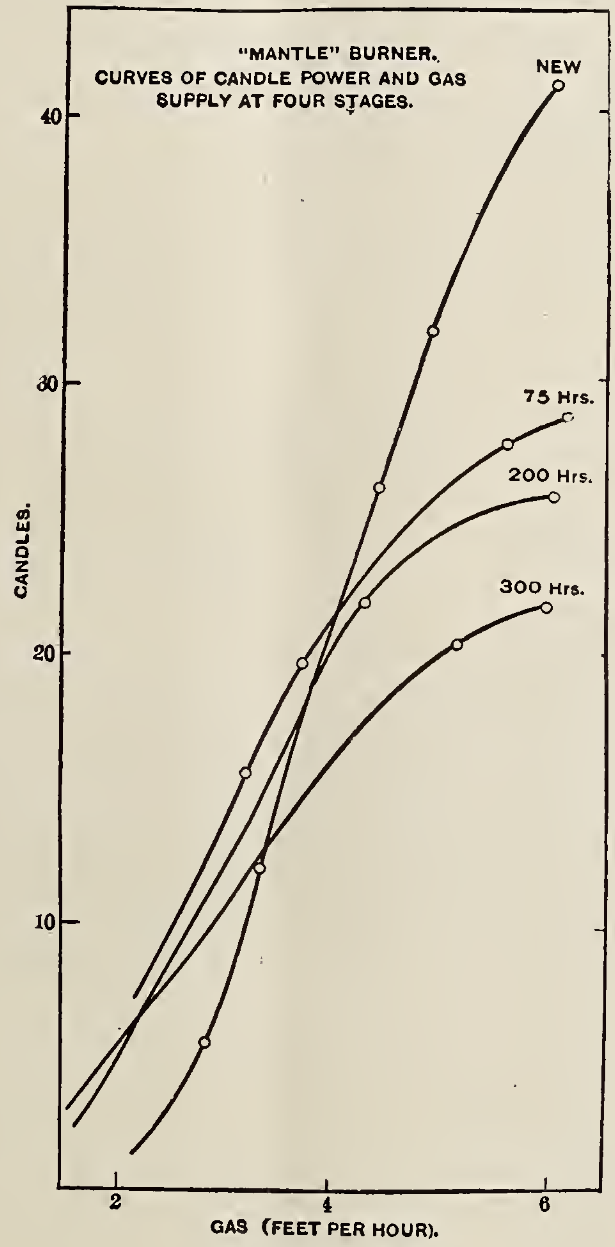


FIG. 22.

arresters. The underground cable is rubber-covered and sheathed with lead, and is of the same diameter as the overhead conductor. It is laid in a subway consisting of vitrified tile ducts, each duct having a hole three inches in diameter. The subway consists of twelve of these ducts, laid eighteen inches below the surface of the ground, and surrounded on all sides by four inches of concrete. Three ducts only are in present use. The insulation of these cables was tested to withstand 80,000 volts.

The subway terminates in a small brick structure erected in the rear of the Niagara street power-house of the Buffalo Railway Company. This contains the step-down transformers. On entering this small house the wires are connected to another switchboard carrying high voltage switches and fuse carriers, separated by partitions of marble, in the same manner as on the high tension switchboard at the Niagara Falls end of the transmission. From this board cables are carried through lightning

ing current at 370 volts is changed into direct current at 500 volts, suitable for delivery to the feeder line of the electric street railway. Each converter armature is provided with three collector rings at one side and a commutator at the other, and may be started either by the alternating current or by direct current from the railway lines. The converters may be used in parallel with the other generators, or the current can be thrown directly into the feeders of the railway system.

The lightning arresters of the Wirt type have been especially designed for heavy voltage transmission work and are single-pole. They consist of strips of marble upon which are mounted eleven cylinders, giving one air gap space one thirty-second of an inch for each one thousand volts, with an allowance of 25 per cent. rise in the potential. In the action of the arrester the large metal cylinders serve to chill the arc, so that, on reversal of the current, the arc is extinguished, no dependence being placed upon any non-arcing property of the metal to

put out the arc. In order to limit the current on short circuit, and thus the heating effect, a special, solid graphite rod of low non-inductive resistance is used. The arresters are similar to those used on the Big Cottonwood transmission at Salt Lake City, which have effectually protected the machinery in many severe storms and are now being used extensively in transmissions where high voltages are employed.

The entire apparatus used in the transmission of the current from Niagara Falls to Buffalo is from the shops of the General Electric Company, having been designed purposely for this special service.

It should be said, in this connection, that the rate of decadence of such burners after about 100 hours becomes very slow. It is possible that mantle burners properly aged by previous incandescence might afford satisfactory standards. This committee has not as yet had the opportunity to test the properties of such a standard.

These data make it evident that if the light from an incandescent metallic oxide is to be used in the production of a primary light standard, the method of composition must be one which continually introduces a freshly formed film. The light of a burning magnesium ribbon fulfils this condition, but there is as yet no practicable method of controlling the combustion of such a ribbon.

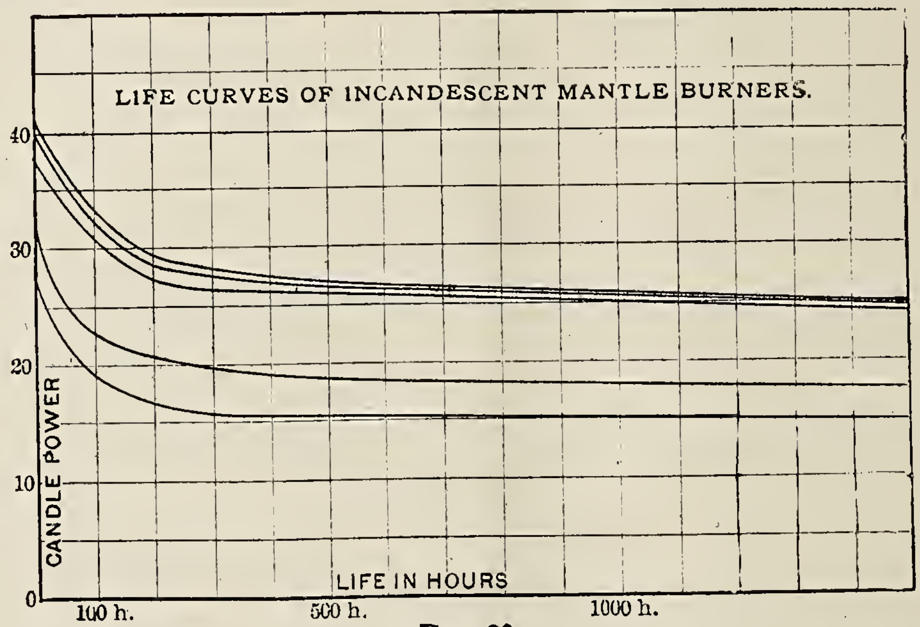


Fig. 23.

STANDARDS OF LIGHT.

(Continued from Page 682.)

Fig. 22, which is constructed from the measurements of Ida M. Hill,* shows the relationship between the candle-power and gas, supplied to a mantel burner of the form in use in 1890, when new, at the end of 75, 200 and 300 hours. Fig. 23 shows the curve of decadence with age of a later type of mantle burner, from the measurements of Mr. Stebbins. It is interesting to note the resemblance between the latter curves and the like curves of the incandescent lamp. It has recently been pointed out as a result of microscopical examinations of this burner, that there is permanent cause of the falling off in the candle-power, namely, a diminution in the radiating surface.†

XVI.

THE GLOW LAMP AS A STANDARD OF LIGHT.

It was at one time thought by some that, under carefully prescribed conditions of manufacture, glow lamps would give a sufficiently constant performance to make them of use as primary light standards. This suggestion, brought forth during the early days of glow lamp manufacture, has been shown to be of little value. During recent years this source has been the subject of exhaustive tests on both sides of the Atlantic, with the result that its behavior is now well known.‡

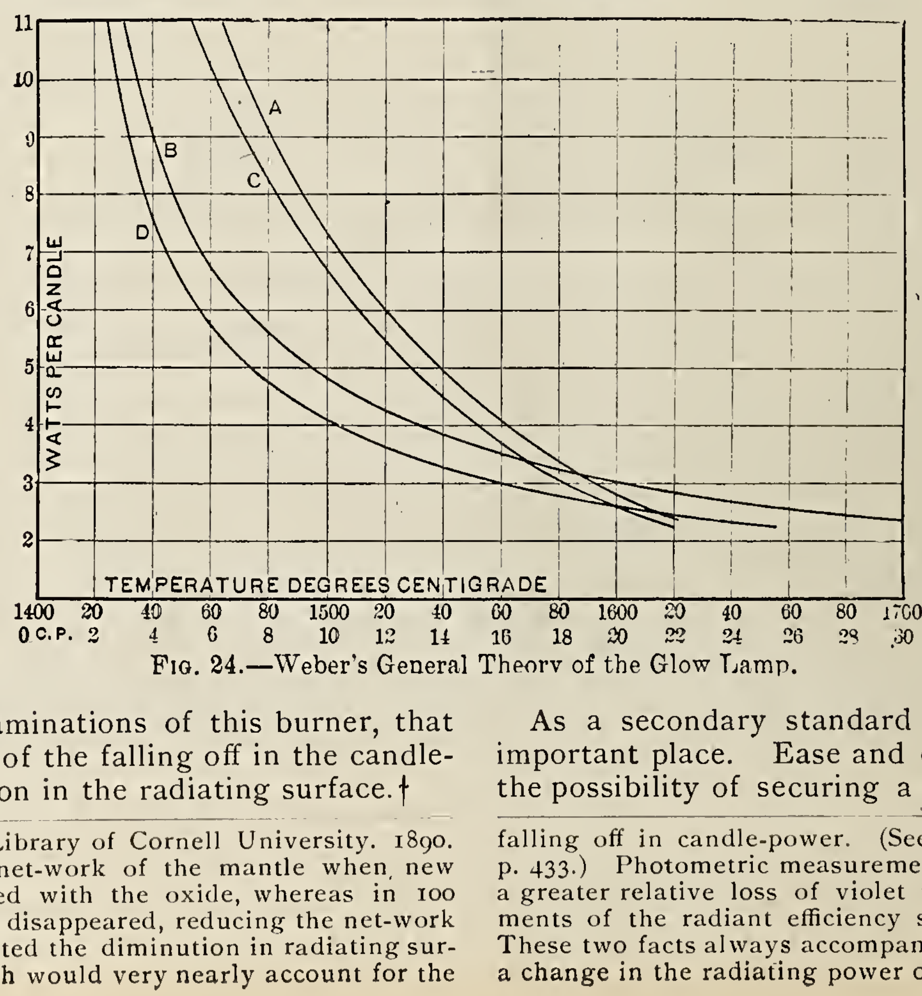


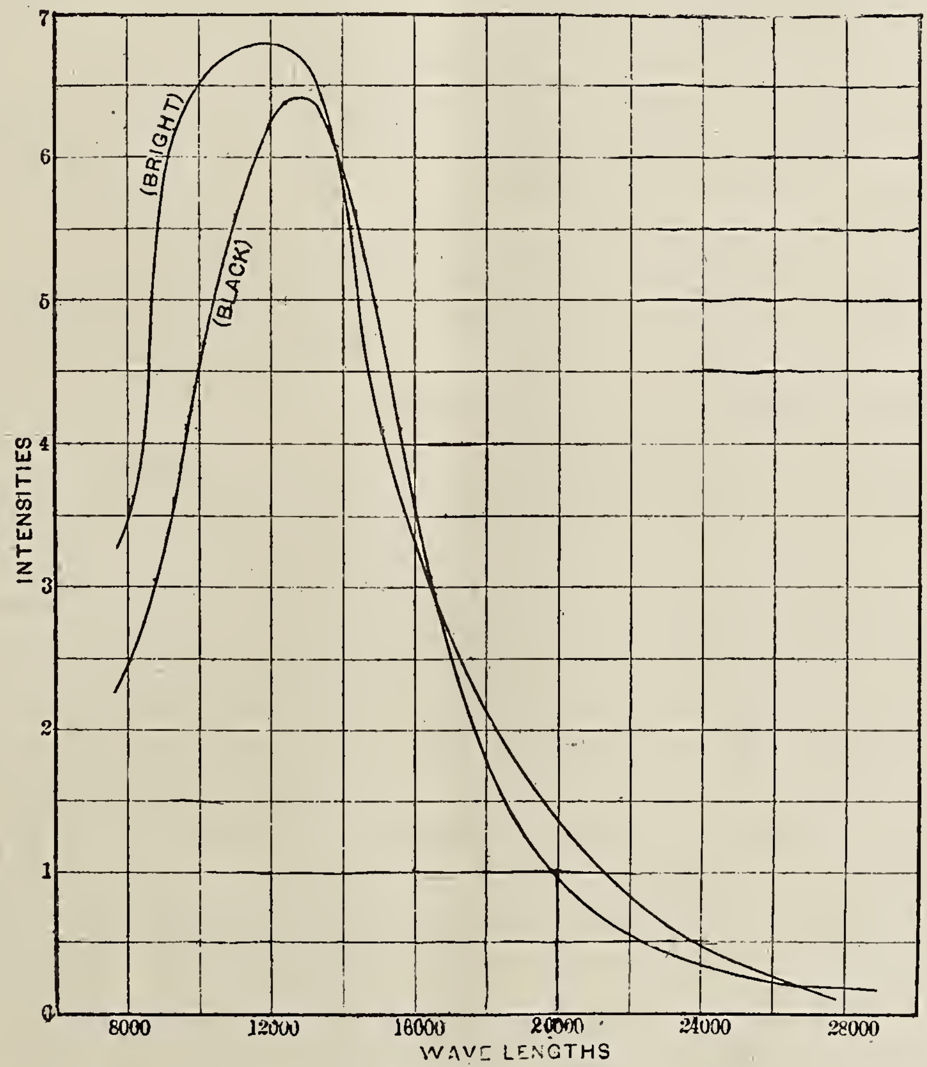
Fig. 24.—Weber's General Theory of the Glow Lamp.

As a secondary standard the glow lamp occupies an important place. Ease and constancy of regulation, and the possibility of securing a standard of nearly the same

* Ida M. Hill, thesis in the Library of Cornell University. 1890.

† St. John found that the net-work of the mantle when new showed interstices nearly filled with the oxide, whereas in 100 hours the material had largely disappeared, reducing the net-work to a skeleton. St. John estimated the diminution in radiating surface at about 50 per cent., which would very nearly account for the falling off in candle-power. (See Wiedemann's Annalen, vol. 56, p. 433.) Photometric measurements of this source show, however, a greater relative loss of violet than of red light, and measurements of the radiant efficiency show that this likewise falls off. These two facts always accompany one another, and they indicate a change in the radiating power of the material.

intensity and color as the light under test, are among its advantages. In fact, the glow lamp may be said to constitute the best secondary source at the command of the photometrist today, and it is accordingly largely used by lamp manufacturers in rating their product. There are, however, certain precautions to be observed in its use. Life tests of the older types of lamps were characterized by a marked fall in candle-power during the early part of their life, after which the change became much more gradual. Recent tests by Ayrton and Medley§ show, in the Edison-Swan lamps, an initial rise in the candle-power. This rise, amounting in some cases to thirty-three per cent. during the first 124 hours of life, is not accompanied by a proportionate increase in energy consumed; that is, the efficiency rises during the early life of the lamp. The spark test shows in these lamps an improved vacuum after they have been burning for some time. That the change in vacuum is the cause of the increasing light intensity does not seem to be established by experiment, since the improvement in the vacuum is found, to a marked degree, in lamps which show but slight rise in candle-power.



But whether the early life of a lamp be marked by rise or fall in candle-power, it is in almost all cases the period of most rapid variation, and hence it is important that this stage should be passed in lamps used as light standards. It is also important that the lamp should not be strained by an excessive voltage, as its later life will be accompanied by rapid decline in candle-power. As soon as an incandescent lamp has been standardized, one or more copies of it should be made and put aside, in order that the original lamp may be examined at any time for change in intensity

The steadiness of the energy supply is, of course, of prime importance. It is difficult to obtain satisfactory results with any source other than storage batteries. Moreover, the electrical measurements to which the intensity is referred must be made with accuracy. Roughly speaking, the candle-power of a glow lamp is proportional to the cube of the watts expended in it, and to secure a constancy within one per cent. in the luminous source, the electrical energy supplies must be controlled within 0.4½ per cent. at least.

How very accurate a secondary standard the glow lamp becomes when properly handled may be seen by a report of the *Reichsanstalt in Charlottenburg.***

Perhaps the most accurate investigation of glow lamps as secondary standards has been made by Lummer and Brodhun,†† at the Reichsanstalt. They compared with each other two 65-volt lamps run at a pressure of little less than 55 volts, determining, by means of one, the change in intensity of the other when the latter was operated many hours.

In order that photometric measurements might be significant to within 0.1 per cent., measurements of current and potential were made accurate to within 0.01 per cent., using Clark cells and resistance of zero temperatures coefficient. Results of the comparison of two lamps, L and R, are given in Table XI.

TABLE XI.

Hours Burned. *R*	4	Ratios of Intensities. L/R
1	1	0.8779
20	2	0.8764
62	3	0.8741
154	8.5	0.8724
211	13.5	0.8677

The position of the glow lamp as the most reliable of secondary standards may be regarded as established. He who seeks to use it as a primary standard, will, however, have to face a number of difficulties. One of the chief of these consists in the fact pointed out some years since by

‡ See, among others: Peirce, Transactions, vol. vi. p. 293; Nichols, N.Y., Electric Club Pamphlets, No. 27 (1890), and Thomas, Martin and Hassler. Transactions vol. ix, p. 271.

§ Tests of Glow Lamps, Phil. Mag., May, 1895.

** Zeitschrift fur Instrumentenkundes, vol. , p .

†† Lummer and Brodhun, Zeitschrift fur Instrumentenkunde, 10, 119, 1890.

Evans,‡‡ that treated and untreated carbons possess very different properties. Weber§§ in his paper on the general theory of the glow lamp has determined the emissivity of the two, and has shown that they are to be regarded as distinct varieties. That the difference between the black and the gray surfaced carbon is not negligible will be evident upon inspection of the curves in Fig. 24. These curves, which have been derived from data given by Weber, give the relations between efficiency and temperature, and efficiency and candle-power, respectively, in the case of lamps with treated and with untreated filaments.

One of the members of your committee‖‖ has shown further that the energy curves of the spectra of lamps with bright and with black filaments are far from being identical.

In Fig. 25 two such energy curves are presented. It will be seen that the curve of the lamp with bright filament has its maximum at a shorter wave length, and that the distribution of energy differs greatly in the two cases.

CONCLUSION.

It is evident from the foregoing summary of previous photometric researches, and from the report of the work of this committee, that of all standards thus far used candles are the least reliable. It is also evident from the bolometric curves that naked flames are subject to sudden and rapidly recurring fluctuations that may be almost entirely eliminated by the use of a properly constructed chimney.

It seems likely that many of the difficulties which are unavoidable with flame standards may be overcome by the adoption of a standard consisting of some surface electrically heated to a standard temperature.

The definition of the degree of incandescence of such a surface appears at the present to present almost insuperable difficulties, but the committee is at work upon a method for the measurement of the temperature of incandescent carbon which may lead to results looking towards a solution of the problem.

It also has in progress experiments looking to the production of a light standard in which not only the burning material but also the atmosphere shall be of known and definite chemical composition. Liebenthal's experiments indicate clearly that this is a necessary condition to the production of any invariable flame. In the preliminary experiments now under way, a flame of a mixture of two parts acetylene to one part hydrogen burns in a current of pure oxygen, all the gases being dry. The flame produced by these means is of dazzling brilliancy, its color being comparable to that of the lime light. No accurate measurements of its steadiness or reproducibility have yet been made.

This experiment will include a spectro-photometric study, as well as an investigation of the range of fluctuation to which it is subject under different conditions of combustion.

HINTS FOR WIREMEN.

Locating a Ground.—A ground is the result of a partial contact between one wire and the earth or gas fittings, etc.; or due to the filtering of current through the entire insulation on account of its poorness. A ground due to contact with one leg of the line may, if tested, be a

High-resistance ground, or,
Low " "

If a low-resistance ground, the extremity of the ungrounded leg and a gas-pipe will be able to supply sufficient pressure to light a lamp. Otherwise, the *high-resistance ground* can only be located by means of a Wheatstone bridge.

Drop in a Wire is calculated by a very simple rule—

$$\text{Drop in Volts} = \text{Current} \times \text{Resistance.}$$

If a wire carries 10 amperes and has $\frac{1}{10}$ of an ohm resistance, the volts lost are equal to

$$10 \times \tfrac{1}{10} = 1 \text{ volt.}$$

The Resistance of the Wire may be found by estimating its length and referring to the wire table for the ohms resistance per 1,000 feet. If 1,000 feet equal 2 ohms, 100 feet equal $\frac{100}{1{,}000} \times 2 = \frac{1}{5}$ ohms, etc.

The Right Size of Wire for a Circuit is found by this rule—

$$\text{Circular Mils} = \frac{\text{Distance} \times \text{No. of Lamps} \times 10}{\text{Volts Drop,}}$$

for a simple 2-wire circuit. For a 3-wire circuit divide by four. *A line 100 feet long*, carrying 100 lights with two volts drop, must be of the following size:

$$\frac{100 \times 100 \times 10}{2} = 50{,}000 \text{ Circular Mils;}$$

or, a No. 5 B. W. G.

With a 3-wire system the size required would be

$$\frac{50{,}000}{4} = 12{,}500; \text{ or, No. 11 B. W. G.}$$

A. Gawalowski recommends the following treatment for files that have been in use for some time: Lead and tin are best removed by nitric acid; the files are then dried in coal dust or sawdust, after whieh they receive a good brushing. Iron grit is removed by dipping into copper sulphate; the precipitated copper does not adhere. Treatment with nitric acid follows, which is, as in the former case, continued until the brown vapors become unpleasant. Zinc is dissolved out by sulphuric acid. For copper, nitric acid is repeatedly applied. Rasps are cleaned in warm sulphuric acid, brushed, dipped into caustic soda, and dried and brushed. The drying can be quickened by pouring spirits over the files and lighting the spirits. To a certain extent these cleaning processes will effect a sharpening. We reproduce these hints after the Allgemeine Technische Verein. But we confess we miss the electric treatment which has been patented several times, and which, in its simplest form, consists in making the file the anode in a bath of sulphuric acid. An external current is, as a rule, not required.

Authorities have differed much as to the rate of increase in temperature from the earth's surface downward, and we are still without any law that is applicable in all cases. Mr. Joseph Libert has recently given this matter considerable study at a colliery in Belgium, where he was able to take observations as low as 3,770 feet beneath the surface. His conclusions show an increase of temperature of one degree Fah. for 53·97 feet of vertical depth. This agrees pretty nearly with observations made a few years previously by another scientist. Mr. Libert says that the law of increase cannot be correctly expressed as arithmetical progression, for the rate of increase is greater at greater depths. For instance, he found at a depth of 2,263 feet the temperature increased one degree for 65 feet of depth, while for depths from 2,263 feet down to 3,770 feet it showed one degree Fah. for 43 feet. Other observations taken at bore holes of still greater depth show such variations that no strict rule can be adopted as applicable to all circumstances.

---

‡‡ Evans, "Proceedings of the Royal Society." 1886.
§§ Weber, Physical Review, vol. ii., p. 112.
‖‖ Nichols, Physical Review, vol. ii., p. 260.

Lamp of the Allgemeinen Elektricitats Gesellschaft.
A, Watts per Candle and Temperature.
B, " " " " C. P.

Sunbeam Lamp.
C, Watts per Candle and Temperature.
D, " " " " C. P.

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CONTENTS.

EDITORIALS ....

Transformers 699

Wide Awake Japanese 699

GENERAL SUBJECTS ....

Electric Power from Niagara to Buffalo 693

Standards of Light 696

Hints to Wiremen 698

Underground Temperatures 698

Electro-Magnetism 700

MISCELLANEOUS ....

Transformation of Electrical Energy 702

INQUIRY COLUMN 702

TRADE ARTICLES ....

Styles of Armatures 703

The Theory of Success 706

Daimler Stationary Motors 706

Ruhmkorff Coils 707

Possible Contracts 708

New Corporations 708

BOOK REVIEWS 707

ELECTRIC STOCK QUOTATIONS 708

TRANSFORMERS.

We are inclined to think that the electrical transformer is a big thing.

Some time ago certain representative men thought that the transformer, the alternating current and, in fact, the entire alternating current system was like the last rose of summer. Its time of life was limited, and its scope much more so. This idea gained considerable ground until the millions of capital expended at Niagara Falls for the installation of colossal alternating-current machines slowly tended to turn the tide of opinion.

It turned quickly when the big generators proved a success. Of course we do not want to harp about the old adage that nothing succeeds like success, but with slight modifications we might say today that nothing succeeds like a transformer.

They are big things *per se*, but become bigger when they are made big.

Their success today in connection with the Niagara Falls and Buffalo transmission plant have stripped away all prejudice to their use or the system they form an integral part of. They are the system; or, we might better say, that without them the system would practically disappear. As a fulcrum upon which the whole scheme rested they have proved a perfect success. The generator, line and transformers composed the triple elements of this plant. Experience that knew no doubt was employed to procure surety. The transformers required a little of it. Vast quantities of power, after leaving the line, are supposed to enter these converters. A great loss in them would promote rapid failure. Their efficiency means life to the company and the furtherance of similar enterprises not only here but in Europe.

WIDE AWAKE JAPANESE.

We notice in the St. Louis Globe-Democrat the following useful bit of information: "American electrical engineers may find it not unprofitable to keep a close eye on the electrical developments in Japan. During the last session of the Japanese Imperial Diet it was agreed to appropriate a sum of above 12,800,000 yen, or more than $14,000,000, spread over seven years, for the extension of the telephone service, and the work of construction is being actively carried on at various important places. The number of new subscribers in the four centres of Tokio, Yokohama and Kobe, under the expanded system, will be over 13,000, and in Kioto and thirty-five other places where the service is to be newly established there will be 6,800. A considerable number of branch lines will also be established in places of less importance, so that telephonic communication will be within the reach of a large part of the population of Japan. The people everywhere are eager to take advantage of this means of communication, and it is stated that at present in Tokio alone there are over 2,000 subscribers, and more than 2,600 applicants are waiting impatiently to have the privilege extended to them also. Arrangements are being made in Tokio to grant 500 new applications during the present year, in order of priority, and during the next two years 1,500 new applications will be accepted, the intention being to increase the number of subscribers until it reaches 10,000. Notwithstanding the activity of the Japanese in these matters, many of the applications which are being granted this year were sent in so far back as 1893. The way is being made much easier for American manufacturers by the marked preference which the Japanese have shown for American methods. This is strikingly instanced in the fact that three electrical experts have lately been sent from Japan to this country for the purpose of studying the latest developments. One of these commissioners says, 'All over our empire now there is the greatest interest in electric power and lighting. Electricity has been introduced in several cities, but the government wants it all over the country. Beyond a thoroughly comprehensive telephone system, we want to generate electricity from the many powerful waterfalls in our country, and to use it for electric railways, general power and lighting, and in connection with our numerous public and private enterprises. It is also our desire to utilize the long-distance telephone in Japan.' That Japan is open to adopt the best electrical appliances of any country is seen in a recent large purchase of camp telegraph apparatus in Berlin for service in Japanese military operations, and it is stated that in future the Berlin material will be imported for the use of the Japanese army. It is to be hoped that those present in this country who are specially interested in the matter will take careful note of these facts."

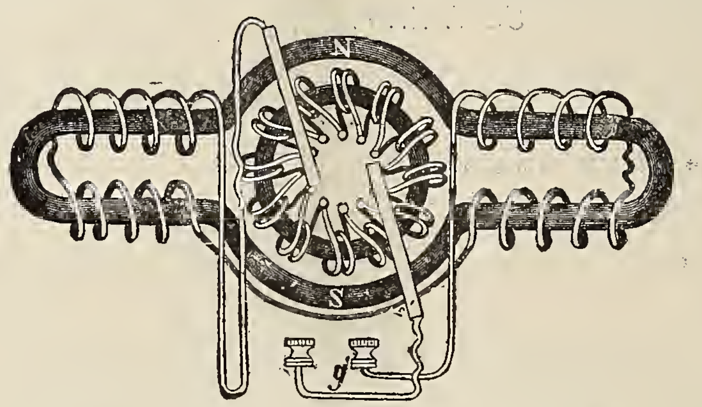
In the first place, it is often thought by even the more intelligent advertisers that the trade journals should immediately bring many replies to a general advertisement —say an enlarged card—simply because the paper is read by people who should be interested in their announcement. This idea is wholly wrong. There may be immediate answers to such general advertisements, but the value of them usually lies in keeping the firm constantly before merchants, and thus it is thought of when they are in the market. In this way the firm may each month gain a new customer, who, buying large quantities of goods, will repay them for several years advertisement, supposing it were possible for no more business to result from that amount of advertising. The fact that one good customer gained each year from a regular advertisement in a trade paper makes a practical return on the investment is too often overlooked.—Trade Press.

ELECTRO-MAGNETISM.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The magnet, whether natural or artificial, advances the idea that certain forms of energy, particularly magnetic energy, has the native quality of discrimination. Certain laws govern this tendency—the attaction or repulsion of poles; but further than this we cannot go except on theoretical lines. We find likewise that when magnetic effects are produced by means of an electric current, the action of unchangeable laws becomes evident and a host of interesting facts follow in consequence.



Application of Electro-Magnets to Simple Motor.

A magnetic field is the space in which magnetic force appears. It has often occurred that a given effect is the result of apparently different causes. In the case at hand attention is to be drawn to the principal means by which magnetism is produced.

(1) Due to natural causes—the lodestone.
(2) Due to contact—the steel magnet.
(3) Due to the electric current—a wire carrying a current.

By coiling the wire all the magnetic energy is concentrated at the centre, and therefore manifests itself there most strongly.

The whirl of magnetic energy around the wire disappears when the current ceases, increases in intensity as its strength increases, and acts in perfect accord with it.

Iron placed in the coil makes it a powerful magnet, because the number of lines of force have been increased by it, and likewise the usefulness of the coil.

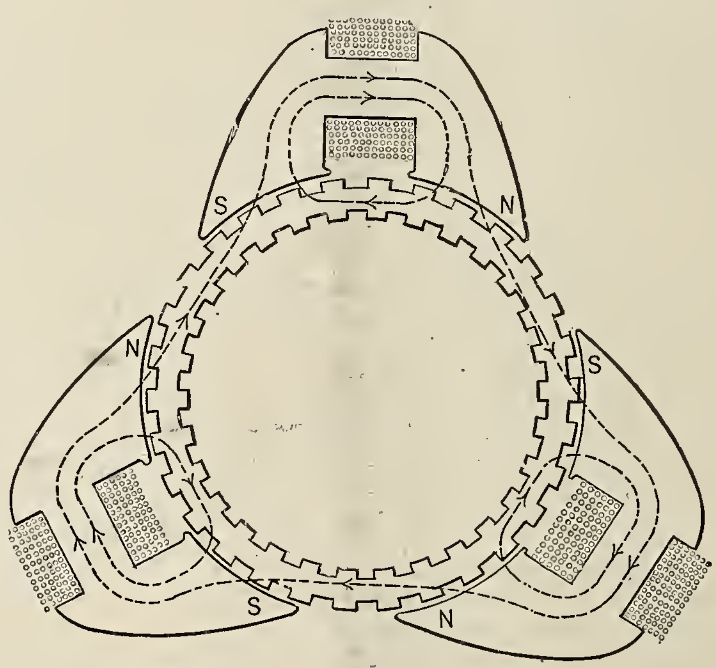
Permeability.—Different materials affect these lines of force when passing through them to various degrees.

Iron increases them.

Nickel increases them.

Copper or air leaves them as before; acting alike.

It seems that iron conducts them, as it were, easier than anything else we know of; but air treats them with indifference, the number neither increasing nor diminishing with or without a vacuum.



Commercial Type—Magnetic Circuit Through Armature.

A coil of wire carrying a current will be found to possess magnetic qualities and has, by investigation with a compass, *both* a north and a south pole.

The strength of the current will have an effect upon the magnetic field the coil produces, as likewise, upon the iron in its centre.

A wire in which a current passes becomes magnetic on the outside to such an extent that a delicate compass is at once affected when brought near.

The strength of the field produced by a coil of wire depends upon

The strength of the current.
The number of turns.

This property of a body to carry the lines of magnetic force is measured by their *permeability.* The standard taken is—

Air	=	1, a fixed value.
Steel	=	800, a variable value.
Soft iron	=	1000, a variable value.

The multiplying effect of soft iron in a coil is so great that its strength has been raised on occasions to a point where 200 pounds pressure per square inch was produced.

The greater the permeability of the iron, the better it is for the building of dynamos.

Wrought iron is best;

then follows Mild steel, and
Cast iron,
arranged according to their permeability.

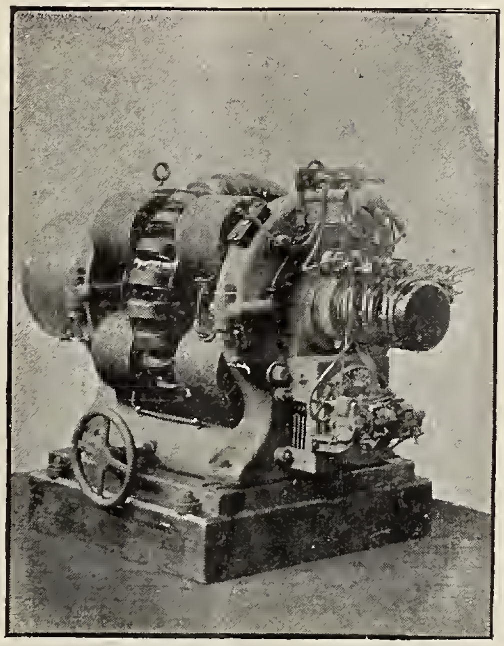
The strength of the magnets, or rather of the iron within the coil, is measured by the *number of lines of force* it possesses to the square inch.

Approximately, Wrought iron takes 100,000.
Mild steel takes 80,000.
Cast iron takes 60,000.

Saturation.—When the iron is carrying as many lines of force as possible it is said to be saturated, in the same sense that water in which sugar is being dissolved will ultimately refuse to carry any more in solution. Actually this stage is never reached, but a condition bordering upon it is such, that enormous power is required to gain a slight increase in lines of force. It is economical in the manufacture of dynamos to keep well within this limit.

A north pole in a coil can be known *without* testing, because it is merely necessary to discover whether in the end of the coil facing you the current is circulating in a direction *opposite* to the hands of a clock.

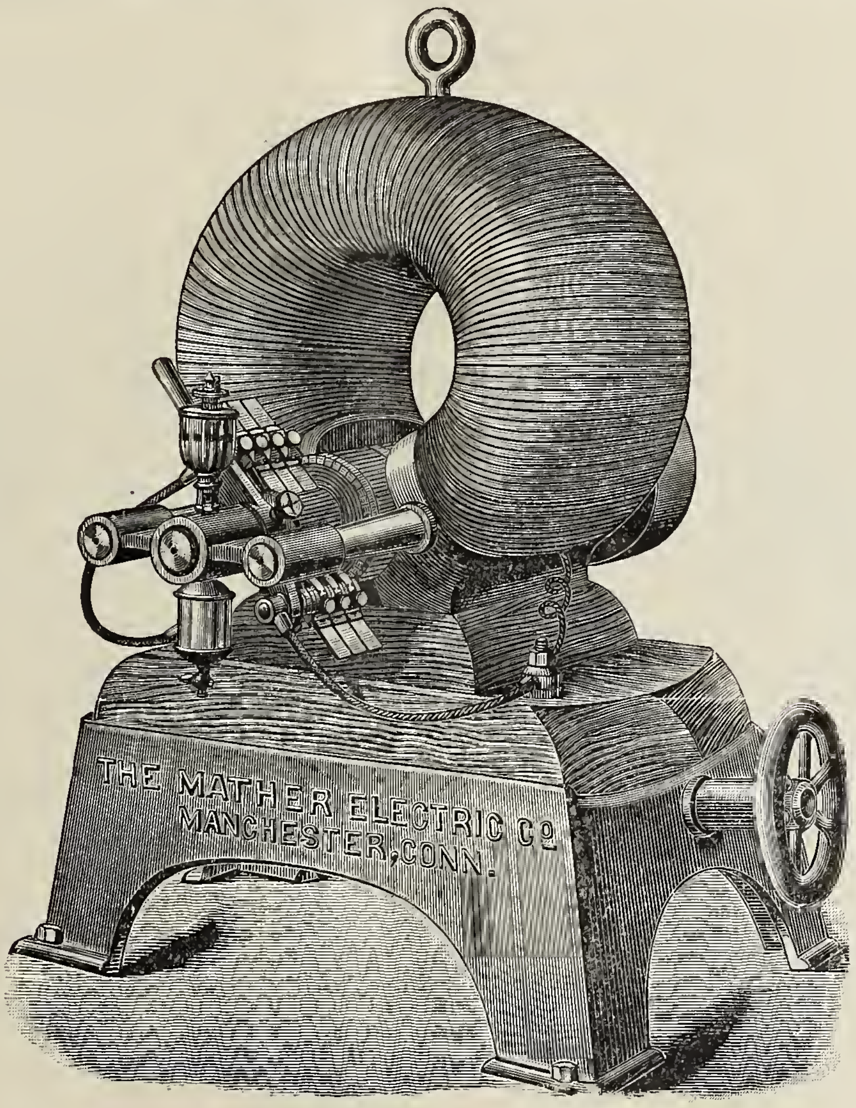
A south pole in a coil is known if the current in that end of the coil circulates *with* the direction of the hands of a clock.



Arc Dynamo—Multiple Electro-Magnets.

The number of lines of force a piece of iron produces with a coil grow very rapidly up to a certain point; then the increase becomes less and less, until ultimately saturation results.

The curve of saturation shows this very clearly; that is, the rapid increase of lines of force due to the turns and current. With a few turns and little current the number of lines of force grow rapidly within the iron; up to a certain point this continues, but even though the magnetizing force be doubled or tripled the lines of force increase but slowly.



Modern Plating Dynamo with Ideal Electro-Magnet.

Ampere turns is the name given to turns carrying a current. One turn carrying a unit of current (an ampere) is called an ampere turn.

The ampere turns acting in 1000 turns carrying $\frac{1}{10}$ of an ampere equals

$$1000 \times \frac{1}{10} = 100 \text{ ampere turns.}$$

The same magnetizing force would be produced by 100 turns and one ampere, or 200 turns and half an ampere, etc.

Turns and amperes are multiplied together to give ampere turns.

Magneto-motive force is the name given to the magnetic force derived from the ampere turns which excites lines of force in air, iron, steel, etc., in quantities depending upon the

Cross section,
Length,
Permeability of the same.

The magneto-motive force = 1.257 × *the ampere turns.*

In any material the number of lines of force are found by the following rule:

$$\text{Lines of force} = \frac{\text{Magneto-motive force} \times \text{permeability} \times \text{cross-section.}}{\text{Length.}}$$

This rule as it stands is applicable at once, if the length and cross-section are given in the metric system; that is, in centimeters and square centimeters; otherwise it must be modified for English measure.

TRANSFORMATION OF ELECTRICAL ENERGY.

In an article in the "North American Review," Robert H. Thurston says that Galvani showed that the nerves could be traversed and the muscles contracted by a current of voltaic or of high-tension electricity, and many later investigators confirmed his statements, while still others have shown that currents actually traverse the muscular and nerve tissues which originate in the body, and which, reversing Galvani's experiment, reveal their nature by all the tests familiar to the physicist as detecting the presence and measuring the action of electric currents from artificial sources.

The potentialities of the animal machine are developed in this direction most strikingly in the gymnotus and many other creatures, in which the currents are produced in great power and intensity, and directed, at will, in the capture of their prey or in self-defence, sometimes disabling a man or felling an ox by their powerful discharges. The fact of the transformation of energy is well illustrated in these cases by the exhaustion of the creature when it has continued this discharge of electric energy a short time. To this extent, certainly, these animals are electrodynamic machines.

The electric eel and the torpedo are but the two best known of about fifty such electro-dynamic animal machines already discovered, and it is thought by some authorities that all animals possess this power of producing and applying electric energy in less degree. Faraday found that the gymnotus, the electric eel, has a storage power equal to that of fifteen large Leyden jars. It is probably well established that every muscle and nerve of every animal is traversed by energy closely related to the electric current, and Duguin calls this "*l'electricite vitale.*"

The New York Central management evidently proceeds on the theory that the more care there is taken of a traveller, the more he will travel—witness its "limited" trains, block signals, free attendants and the comfort and luxury surrounding one from beginning to end of a journey on "America's greatest railroad."

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—HOW TO CHOOSE A DYNAMO.

Pittsburgh, Nov. 20, 1896.

Electrical Age Pub. Co.

Dear Sirs:—I am an engineer in charge of a plant which will need additional power very soon. If I use another dynamo, shall I take an iron-clad or a bipolar Edison? You have assisted me in the past year very much by your answers. I can recommend you to all my friends.

Yours respectfully,

Julius Shultz.

(A.)—The choice of a dynamo is a matter of opinion. If the dynamo is likely to be ill-used in any way mechanically, have an iron-clad put in. Otherwise, an Edison will serve your purposes.

(Q.)—STOPPING A TROLLEY CAR.

Brooklyn, Nov. 21, 1896.

To the Editor of the Electrical Age.

Dear Sir:—Can you let me have a little information about a trolley car? Can it be stopped by crossing the poles when the trolley wheel is off? I have tried it and I think it works. It is a wonder to me the traction companies do not use this idea. Yours truly,

James Darcy.

(A.)—When you cross the poles with the car disconnected from the trolley wire, you use the motor as a dynamo. It acts as a brake, and might burn out fuses if sufficient speed and headway were given to the car. This is one of the difficulties met with.

(Q.)—WHY MUSCLES CONTRACT.

(Translated from the Spanish.)

Los Angeles, Nov. 10, 1896.

To the Editor.

Dear Sir:—It is my happiness to address you. I am desirous of knowing a little fact of the utmost importance. It refers to the human muscle, which draws together by the influence of the electric current. I do not know why this is so, but I think your column of Inquiry will illuminate my mind. I shall be delighted to return this pleasure. Yours faithfully,

Juan Carmello.

(A).—We answer in English. A thoroughly dead muscle cannot be contracted; that is, if it becomes stiff. The nerve is affected and exercises all the reflexes due otherwise to natural volition. This stimulation of the nerve, even for a short time after death, to the extent of controlling the muscle once more, is beyond us.

(Q.)—BATTERIES FOR CHARGING STORAGE CELLS.

Chicago, Nov. 14, 1896.

Dear Editor:

Storage batteries are so good for experiments, etc., that I built a set of twenty-five. The charging of them bothers me; what would you suggest as the best thing for the purpose—an acid primary battery or a gravity cell? Yours truly,

Alfred Harlon.

(A.)—Primary battery charging is best with gravity cells or some form of bluestone giving a pretty strong current. Acid batteries will not do; the Gordon-Burnham is good for this purpose. But the use of from twenty-five to fifty cells of primary battery would almost do your lighting, if on a small scale, without any storage cells.

Harvey Middleton, general superintendent motive power of the B. & O. R. R., has organized fire departments at all the shops along the road.

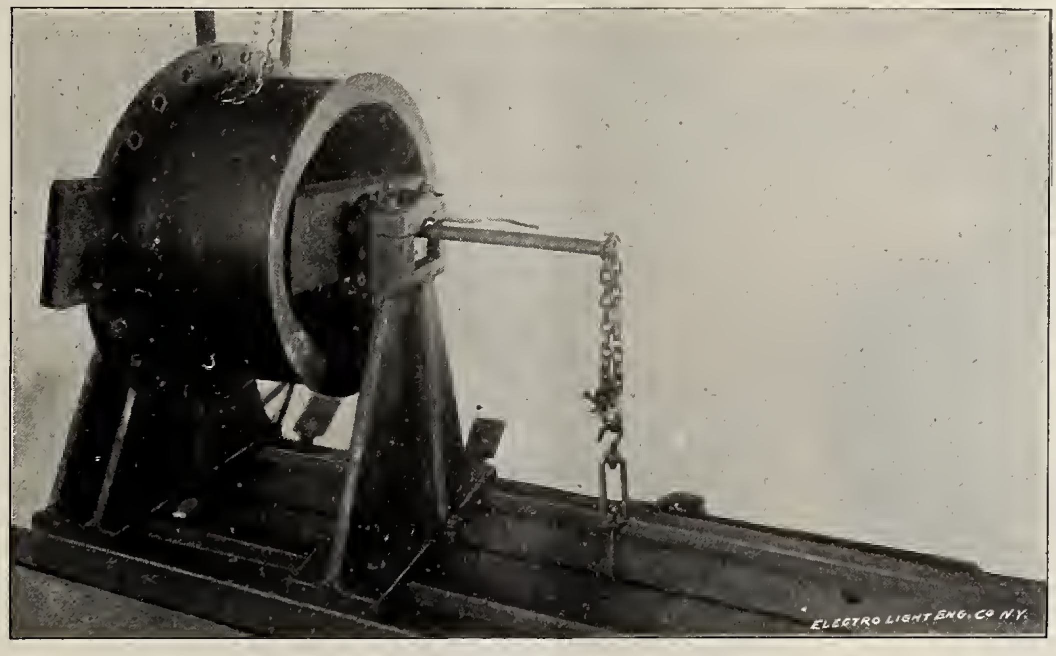
ITEMS.

In the Brooklyn Eagle it is stated that there are eight storage battery roads in Europe, four of which were installed during the past year. The largest system of this type comprises three roads in Paris, operating nineteen storage battery cars, some of which have been doing duty since 1892; and the addition of a third road last May seems to indicate that for the conditions there existing the storage battery has proved satisfactory. The other four roads are located—one at Birmingham, England; one at Hague-Scheveningen, Holland, and two in Austria-Hungary.

The electric candle is in great request in England for the lighting and decoration of dining and other tables. An ingenious device for lighting the candles is provided by placing small pads under the tablecloth, and taking the current from them by means of two pin points in the base of the candlestick. The candles, of course, are extinguished on being taken from the table and are relighted when they are replaced in the proper position. They are so arranged that the bulb and the glass imitation of a wax candle can be removed, when the candlestick can be used for an ordinary candle. When used with shades of colored silk, the electric candle makes one of the prettiest additions to a dinner table that is possible to imagine.—Machinist.

STYLES OF ARMATURES.

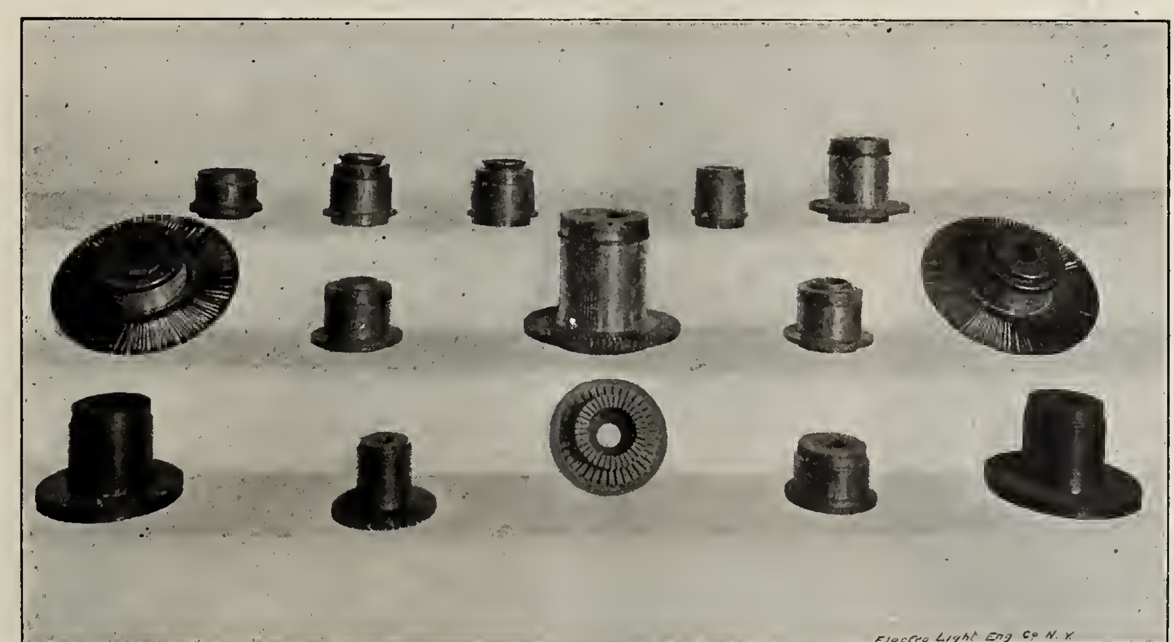
For the benefit of our readers we publish cuts of a choice collection of armatures. They were obtained through the courtesy of Mr. Chesley, whose repair shop in Hoboken undertakes renovation of all kinds and descriptions.



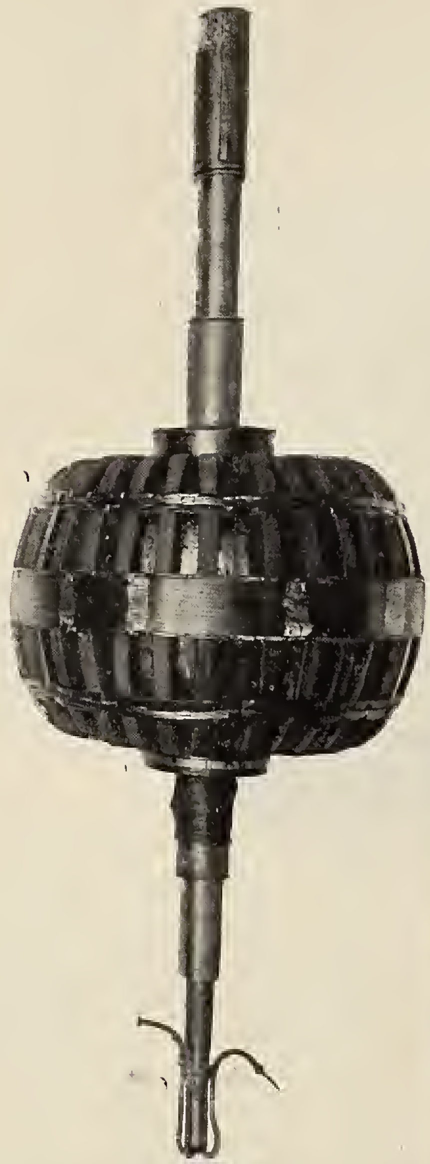
Fleld Magnet—50-Light Thomson-Houston Arc Dynamo.

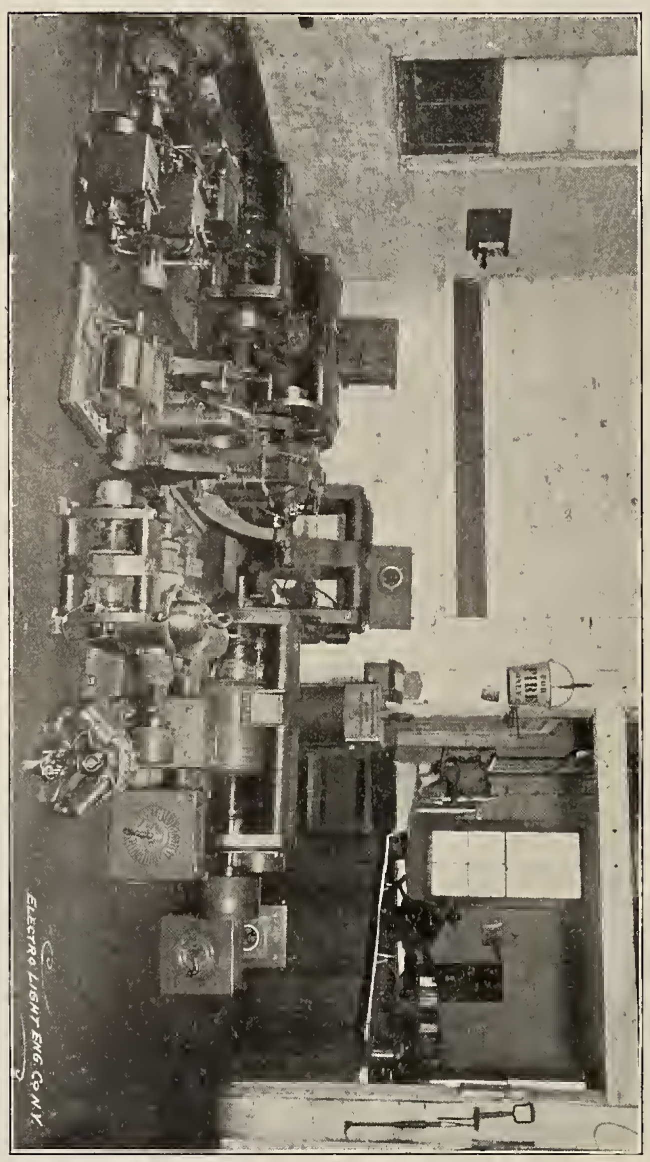
The gentleman we speak of has built over 500 commutators, and the instructive series of sketches that follow covers some of these and many types of armature. The field magnet of a Thomson-Houston arc dynamo is laid bare and the method by which it is handled. The T.-H. ball armature and the improved style of ring, T.-H., are likewise illustrated.

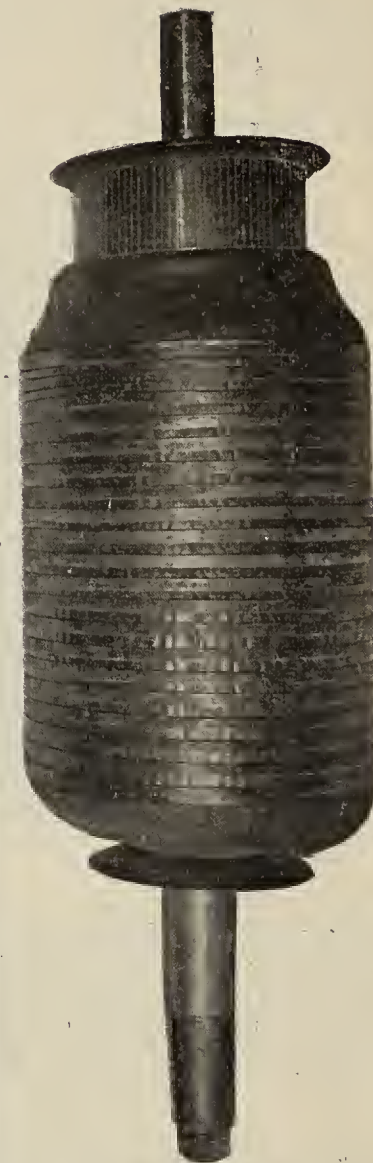
It is a study to compare the different makes with their noticeable variations and characteristic differences. The greatly strained arc armatures with their heavy voltages necessitate separated coils, good ventilation, substantially built commutators, and, above all, perfect insulation. In the T.-H., Brush, Excelsior of either make, and the American armature these ideas are carried out as far as possible. Arc light armatures, because of the pressure and rough practice, meet with many a hard knock in the course of their life of usefulness. The alternating current armature, of 750 lights capacity at 1000 volts, the 500 volts 120 H.-P. Edison armature and the Westinghouse street railway motor, in the illustrations, are examples of what the conditions of work will do towards modifying



Commutators.
50-Light, American Arc. 45-Light, Excelsior Arc. 100-Kw. (120 H.-P.) Edison and Others.







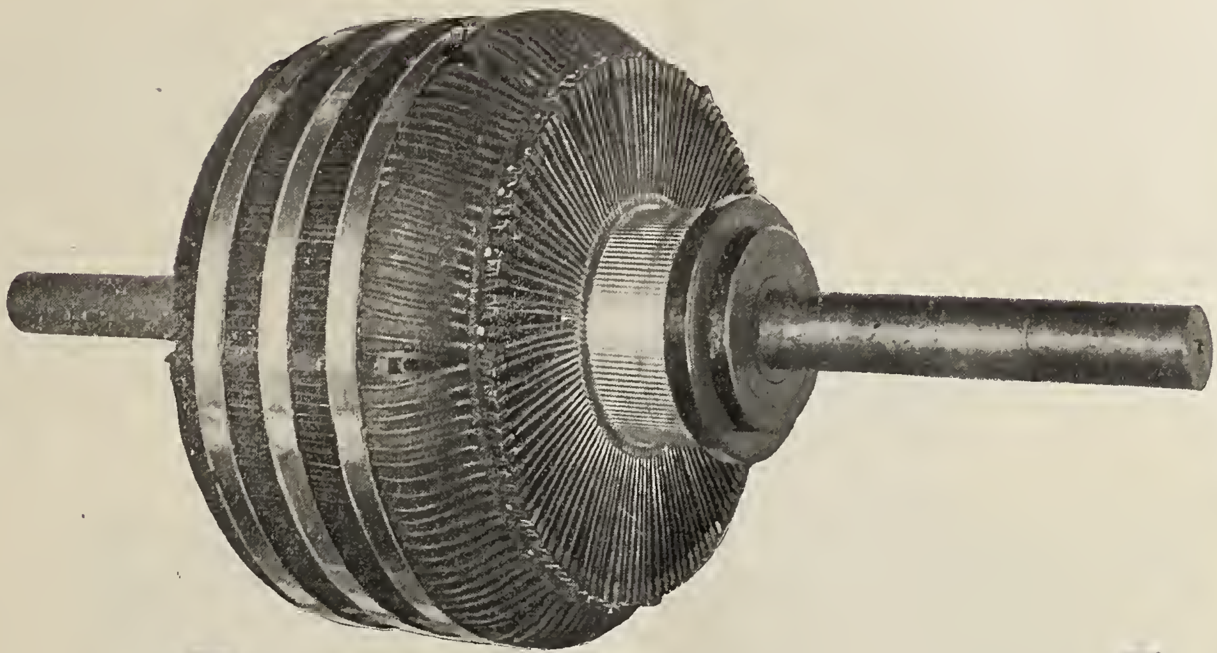
Westinghouse Street Railway Motor Armature.

50-Light, 2000 C.-P. Thomson-Houston Ring Armature.

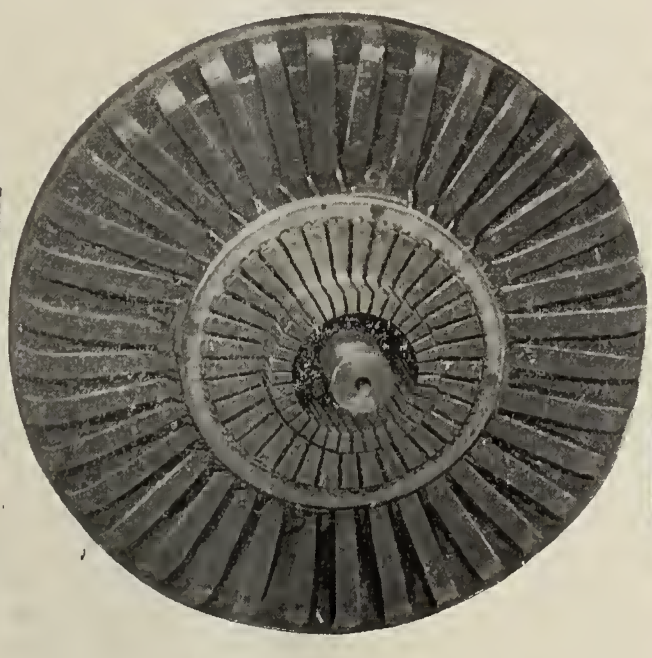
Dynamos and Motors.

45-Light, 1200 C.-P. Excelsior Armature.

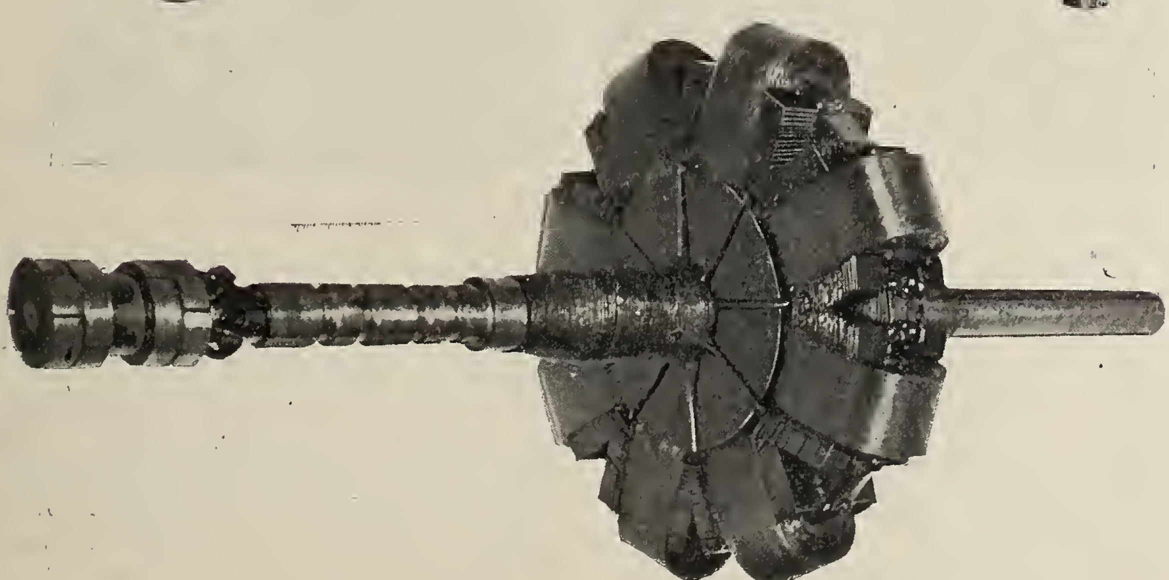
50-Light, 2000 C.-P. Thomson-Houston Spherical Armature.



60-Light, 2000 C.-P. American Armature.



750-Light, 1000-Volt Westinghouse Alternating Current Armature.
150-Light, 1200 C.-P. Excelsior Armature.
500-Volt Armature.



45-Light, 1200 C.-P. Brush Armature.

the form. Yet it seems that the most careful insulation of armatures is, even for a few volts, almost as essential as that of one to give a thousand. The great range of work to be met with in a good repair shop, the means that must be employed to meet certain ends, give to this department of work the most dignified position of all.

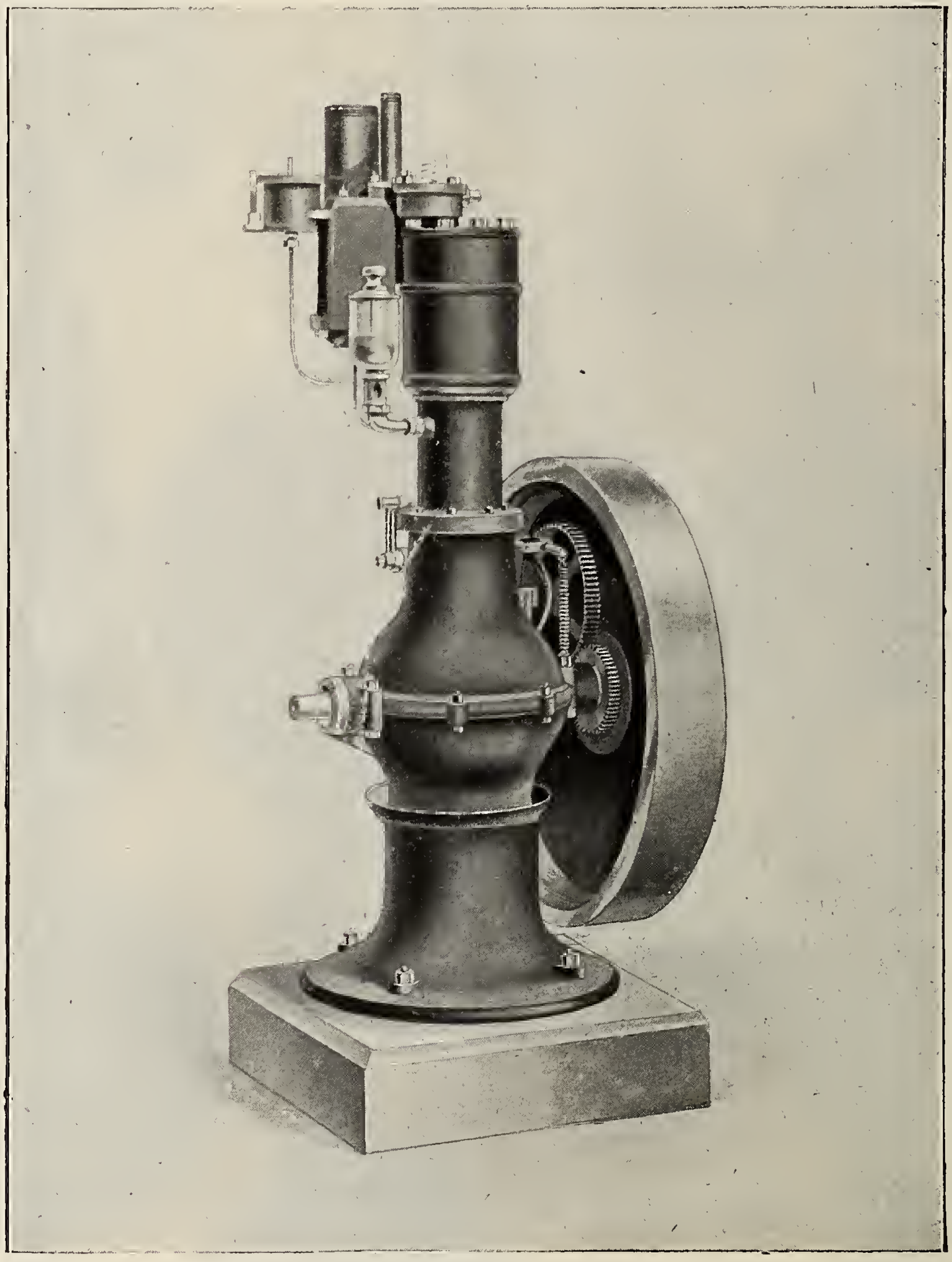
The home and hospital require nearly all the time and highest skill of the civilized human race to found. In like manner the abused machine, either injured by accident or avoidable carelessness, finds its way to the repair shop to be made whole, and then sent out to continue its career of usefulness.

The diversity of makes received can be imagined from a view of the interior of a room containing machines awaiting repair, as seen in the illustration.

DAIMLER STATIONARY MOTORS.

A source of power for driving dynamos, either in town or country, that will not wipe out the advantage of convenience by the disadvantage of expense is brought to the reader's notice in the Daimler motor. At one time in their period of development they were operated only by gasoline or illuminating gas; but this is of the past, and the latest form of the Daimler motor used to the same advantage, with the same efficiency, and a greatly decreased expense is due to the use of kerosene oil.

Country residents are only too familiar with kerosene, but that familiarity would not have the disagreeable recollections and experiences they have today if, instead of an eloquently odorous lamp, they obtained by its use the brilliant and incontestably superior light of the day, the unequalled excellence of the electric light.



Daimler Stationary Motor.

The Daimler motor offers these great gains to all on an excellent commercial basis.

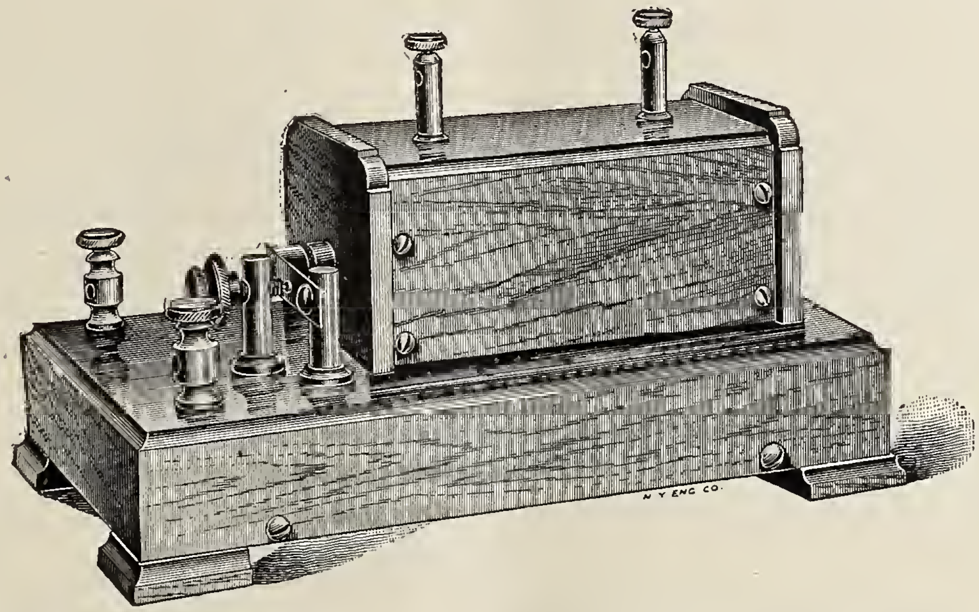
The constant cleaning of valves and of interminable care is absent. By means of a system of perfect combustion these difficulties are overcome and, whether for electric lighting, pumping, dairies or sawing wood, these motors take the lead. In compactness, cost of working, reliability and, lastly, price these motors defy competition. Their sizes run from 1 to 25 H.-P.

Keewatin, Ont.—The Keewatin Power Company is preparing to utilize the water power secured through its dam, at this place, by making a contract for the transmission of 5,000 horse-power to Winnipeg. The company is prepared to enter into a contract for constructing the necessary works in connection therewith.

Toronto, Canada.—The Fensom Elevator Works, 52 Duke street, are in the market for all kinds of electrical goods, especially four, five and six-drop annunciators, complete.

At home, the use of private plants will receive an impetus from the introduction of these motors that will keep all the dynamo makers hustling to meet orders.

For railway inspection cars, horseless carriages and yachts they are finding a ready sale. The Daimler Motor Co.'s address for office and manufacturing works is 937-947 Steinway avenue, Long Island City, N. Y. Showrooms in 14th street near Fourth avenue, New York City.



REVIEWS.

The American Street Railway Association have issued a *verbatim* report of their last proceedings, carefully revised and bound in pamphlet form. It is not only a testimonial to the members of the A. S. R. A., but to the accurate work of those entrusted with the labor of compiling the official addresses, discussions and papers.

Alternating Currents and Alternating-Current Machinery, by D. C. and J. P. Jackson, is a volume presented for our criticism by The Macmillan Co., 55 Fifth Avenue, N. Y.

The ability of its authors has long since been recognized; yet, although the recommendation a book receives is generally based upon the talent or genius of its writer, we will carefully turn over this volume's pages and speak unbiassedly of the quality of its written contents.

The student with a solid foundation will admire and extol the nature of the work contained therein. Accustomed, as he must be, to diagrammatic expositions and the use of concise mathematical statements, the book will be in perfect harmony with his past work.

The chapter treating of the design of transformers is thoroughly practical; it heralds important conclusions and gradually leaves the preliminary field of inductive and capacity effects. The chapters are examples of lucid explanation; they advance the mind, step by step, to the final issue, and lay bare all of the important principles in the design of the alternating-current motors and polyphase transformer.

The book is up to date and conscientiously written, because the authors have included the corner-stone in the appendix, "Fourier's Theorem," and added important matter concerning "Oscillatory Discharges" and "Electrical Resonance."

It may be read with the deepest satisfaction by any earnest student of electro-technics.

The Elements of Physics, by Edw. Nichols and Wm. S. Franklin, vol. ii., sold by The Macmillan Co., of 55 Fifth avenue, is one of three volumes, the copy we have in hand being specialized by the above title.

The introduction is only interesting to an advanced student, because it treats at once of "Distributed Quantity" in language above the saints. The technical has given way entirely to the abstract in the introductory chapter, although further on the contents become more interesting. Chapter VI, on measurements by indirect methods, is very useful, as well as the succeeding work on electrostatic effects and the phenomena of discharge. The chapters on induced E. M. F. and electric signalling are quite good and the final short sketch, chapter XVI, of Maxwellian odor, is an example of the complex made simple, of some difficult theories carefully and clearly outlined.

On the whole the volume is a notable addition to the electrical high-class literature of the day, and represents considerable labor as well as a desire to inculcate the fundamental principles underlying each new class of phenomena with faithful accuracy.

RUHMKORFF COILS.

The development of X-ray work has called to the front a great collection of spark coils. They are like humanity itself in their quality and usefulness, being good, bad and indifferent.

Edwards & Co., of 144th street and Fourth avenue, N. Y., make a beautifully finished and reliable spark coil. These coils are guaranteed and fill the bill in every particular, being high grade, high finish and highly thought of.

The following prices will give an idea of how good an investment may be made in these coils.

¼ inch	$10 67	1½ inch	$48 00
½ "	18 00	1¾ "	60 00
⅝ "	24 00	2 "	72 00
¾ "	33 34	2½ "	96 00
1 "	40 00	3 "	120 00
1¼ "	42 00	4 "	150 00

Purifying Saccharine Juices.—An electrical process for the purification of saccharine juices is said to give satisfactory results. The percentage of lime used need only be about one-half that required by customary methods, and by reversing the current the electrodes may be freed of their deposits.—Philadelphia Record.

The "Philadelphia Record" believes that the Japanese nation is the first Oriental nation to fully appreciate the advantages of the electric current. This country has electrical engineering colleges, publishes a paper devoted to electrical interests, and yearly expends large sums of money sending representatives to foreign countries to investigate the practical applications of electricity. It has quite extensive telephone connections, and is at present laying a submarine cable, manufactured in England, but laid entirely by Japanese engineers, and, moreover, is adopting the trolley as fast as circumstances will permit, changing over after the American style the various horse-car lines, especially those of any considerable length. Indeed, in this respect Japan is ahead of some of the Continental countries of Europe.

POSSIBLE CONTRACTS.

Philadelphia, Pa.—Hales & Ballinger, architects and mill engineers, are receiving bids for the erection of a three-story brick addition to the manufactory of Fels & Company on Tinicum Island Road.

East Braintree, Mass.—The Automatic Electric Pump Co. of Boston has purchased a large lot of land on Commercial street, and will at once erect a two-story factory and a brick boiler house.

Several smaller buildings will be included in the plant for the manufacture of brass and iron findings and fittings.

Philadelphia, Pa.—Newhall & Co., architects of the Union Sugar Refining Company, which will erect a large sugar refinery adjoining the United States Sugar Refinery, received proposals for the erection of the plant, and as soon as the bids are scheduled the contract will be awarded.

Plans for work at the Art Club, costing about $20,000, have been prepared, the improvements contemplated being the enlargement of the cellar and the putting in of new boilers, engines and dynamos of the most approved pattern.

Philip Haibach has the contract and is about to being work on a four-story stone, brick and iron brewery building at 606 and 608 St. John street. It will cost $27,000.

A communication from the Citizens' Municipal Committee urging upon councils the immediate introduction of an ordinance appropriating $500,000 for public electric lighting for 1897, was referred to the Finance Committee.

Bay Shore, L. I.—A plan for using electricity to light the streets of this village is just now being agitated by a number of the leading members of the Village Improvement society. There is an electric light plant in operation here now, with lines in every street, so the matter could be settled with very little difficulty or disturbance. If the plan should be carried out, the lamps will be placed 300 feet apart on both main and side streets.

Parrsboro, N. S.—Dr. J. R. Smith has secured from the town privileges to erect an electric light plant.

NEW CORPORATIONS.

New York City.—Bell Electric company has been incorporated to deal in electric appliances. Capital, $150-000, and directors: Clifford E. Porter, John Dozier Pow, Henry E. Cornwell, Frank M. Bell, John R. Keim, Simon Frankel and William C. Bread.

Greater New York Electric Light and Power has filed articles of incorporation. Capital, $5,000.

The Mexican General Electric Company, of Schenectady; to deal in electrical apparatus and to install electric plants in the Republic of Mexico and other foreign countries. Capital, $50,000. Directors: S. D. Greene, Henry W. Darling, D. Mazenet, J. R. Lovejoy and M. F. Westover, of Schenectady.

The B. & O. R.R. has recently made some important improvements in the Philadelphia terminals. A new pier has been made at No. 12 North Wharves, and the handling of freight at that point has been greatly facilitated. It is claimed that three times as much freight can be handled now, with the new facilities, as under the old methods.

ELECTRIC STOCK QUOTATIONS

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
Edison Elec. Illg. Co., New York,	101	102
Edison Elec. Illg. Co., Brooklyn,	98	101
Edison Ore Milling Co.,	—	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co. T. Sec. Series A,	2½	4
General Electric Company,	33	34
General Electric Company pf.,	70	75
Hartford (Conn.) Elec. Light Co.,	—	20
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81	83
Rhode Island Elec. Protec. Co.,	—	122
Royal Elec. Co. (Canada),	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse Elec. & Mfg. Co.,	26	28
Westinghouse El. & Mfg. Co., pf.,	50	51
Westinghouse El. & Mfg. Co., assd.,	—	28

*Ex dividend.

The Electrical Age.

VOL. XVIII., No. 23. NEW YORK, DECEMBER 5, 1896. WHOLE No. 499

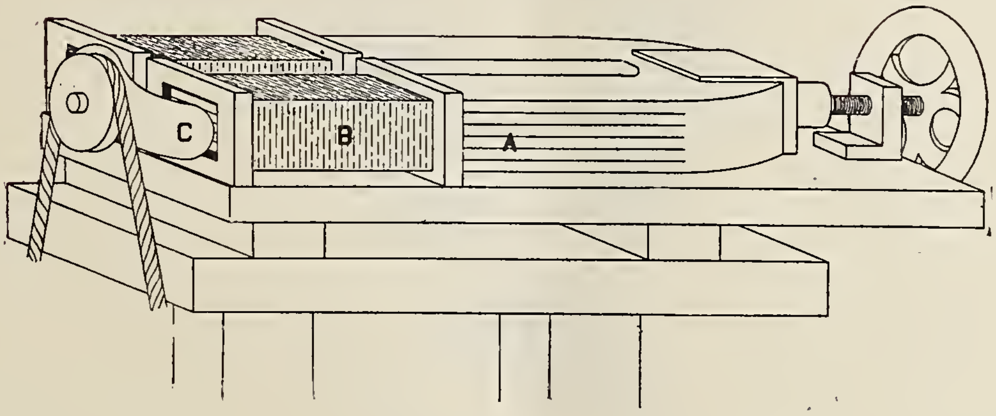


FIG 1

KNIGHT 1854

SOME ACCOUNT OF THE EVOLUTION OF THE INDUCTOR ALTERNATOR.

BY JOHN F. KELLY, PITTSFIELD, MASS.

Read before the National Electric Light Association.

In beginning this brief sketch of the evolution of the inductor alternator, I wish to define my conception of the type, and I have found it necessary to include some machines not usually regarded as inductors. An inductor alternator, as I understand it, is one in which the electromotive force in the induced coil is the result, not of changes in the space relations between such coil and the flux-producing agency, but of changes in the flux through said coil, brought about by the motion of iron pieces serving as magnetic conductors. When the flux is due to an exciting coil, the foregoing definition requires constancy of the space relations between the exciting and the induced coils, and in general this constancy of relationship is mechanically expressed by the entire immobility of both coils. It is, however, possible that the inducing coil should turn on its axis without in any way altering its relationship to the induced, and in some cases this is the construction adopted.

As a means of producing electric energy on a large scale, the inductor alternator is the latest claimant for public favor, and yet it is far from being a new-comer. Its advantages have been apparent from the earliest days of the art, and a long series of distinguished inventors have worked at its development. Although until about eight years ago it was an extremely inefficient generator, its extreme simplicity secured it an introduction when not much power was required. Indeed, if we bear in mind that the Bell telephone, considered as a translating device, is an inductor alternator, we shall have to regard the inductor as the most widely used type of alternator. Our concern here, however, is only with machines useful in large sizes, and any others are of interest only as foreshadowings.

I shall first call your attention to Knight's machine, shown in Fig. 1. This machine was patented in 1854 in England. Its defects are obvious, but it should not be overlooked that it is not worse than its rivals of other types, and, indeed, no worse than most of the modern magnetos for signaling purposes, while it is unquestionably of a more robust construction. Henley's machine, Figs. 2 and 2a, consists of an inducing magnet with an electro-magnet set between its poles and in a plane at right angles to them. A double series of rotating keepers connects first one pole of the electro-magnet to the north pole of the inducing magnet, and the other to the south pole, and then reverses these connections, thus giving use to an alternating flux through the electro-magnet. Figs. 3 and 4 show an interesting design of Wheatstone's. There is but a single induced coil, within which moves an iron cylinder provided at each end with radial polar extensions. This single coil form has been taken up again by recent inventors, but has not yet come into use. Like Knight's machine, this of Wheatstone's suffers from the great variation in the magnetic flux in the inducing magnets. Wheatstone says that the inducing magnets in this machine may be electro-magnets. Fig. 5 shows another design of Wheatstone's, which shows considerable improvement over the other. The variations of magnetic flux are here confined to those portions of the magnetic circuit in which it is necessary they should occur. The flux as a whole is steady, and the machine operates by its varying distribution, the keeper now directing the flux through one pair of induced coils, now through the other. Wheatstone does not appear to have had this reason in mind in

* The almost exclusive reference to English inventors in this paper is not due to underrating the efforts of others, but solely to lack of space and time. It would have been impossible to give adequate recognition to all, and it happened to be more convenient for me to trace the development along English lines until the last stage than along any other. I have no doubt that a parallel history might be written for any of the important cultured lands. At the present time the art of inductor building is more highly developed in the United States and on the European Continent than in England. Indeed, a mere mention of the names of the engineers on the Continent engaged in the development of inductor machines—Sohlmann, Dobrowolsky, Arnold, Kolben, Brown and Thury—is sufficient evidence that their work must be of importance.

duplicating the induced pair of coils. His object appears to have been to secure a smoother electromotive force curve. This machine was introduced into telegraphy, and I am assured by Mr. Stephen D. Field that it gave first-class service. The Lippens machine, shown in Fig. 6, is so like Wheatstone's first design that it needs no description.

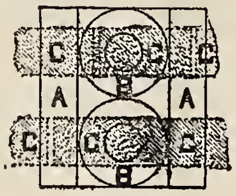


FIG. 2-A.

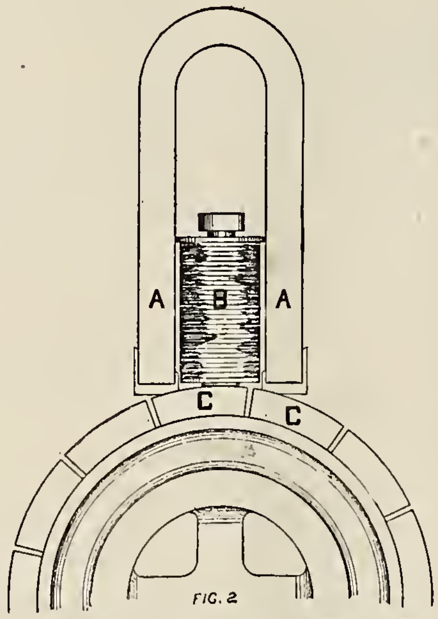


FIG. 2

HENLEY 1856.
A A INDUCING MAGNET
B B INDUCED COILS.
C C. KEEPERS.

(To be continued.)

THE MAN AND THE MACHINE.

It is an old cry and one that has frequently been raised during the present century of industrial development, that improved machinery is the hostile competitor of the workingman. With the introduction of each new labor-saving device it was freely predicted that capital would be enriched, labor impoverished. It was so with the cotton-gin and the loom; with the locomotive and the reaper; with the sewing-machine and the typesetter. In each case the prophets were false prophets; not because they loved lying, but for lack of knowledge. Their outlook was too narrow. They mistook the little circle which included their own particular interests for the broad area of the industrial world at large. * * * * Just now the country has fallen into the trough of that phenomenal wave of prosperity which passed over it from 1886 to 1892. The cause of the present depression lies very deep; too deep to be touched by any mere legislative act. It is to be found in certain immutable laws of supply and demand which operate (as we are now finding

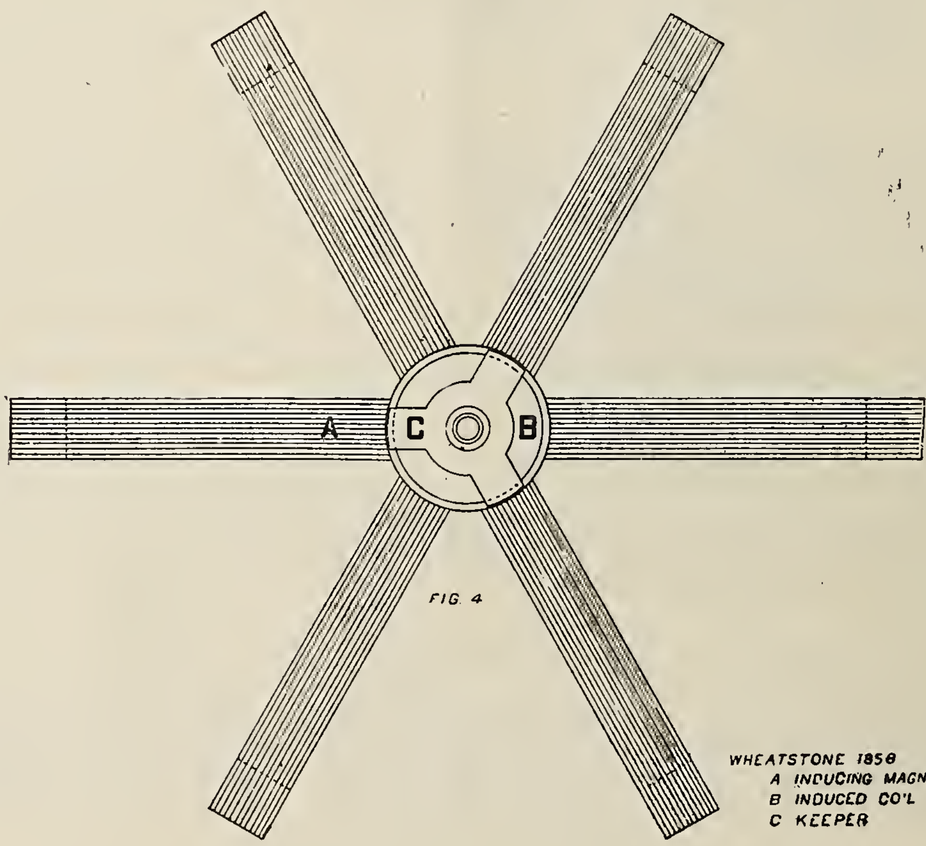


FIG. 4

WHEATSTONE 1858
A INDUCING MAGNET
B INDUCED COIL
C KEEPER

out) as resistlessly in the new world as they have done in the old. But whether the scarcity of employment be due

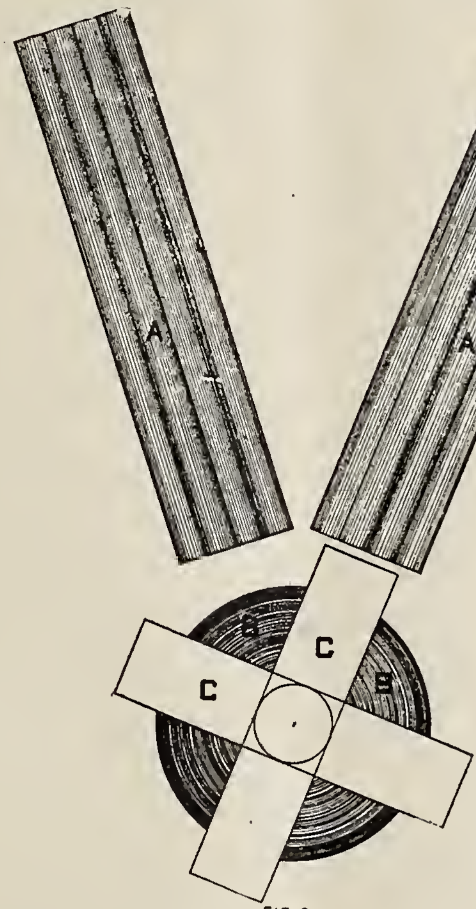


FIG 6

to the scarcity of the demand for the product of labor or not, it may be written down once and forever that it is

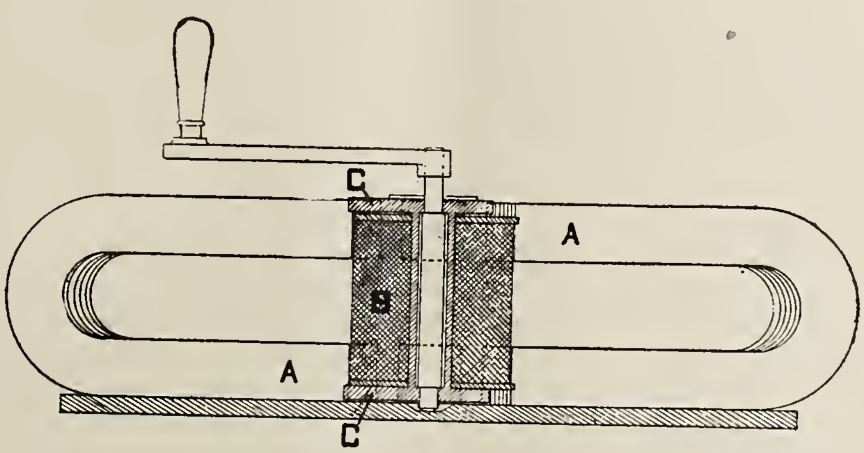


FIG. 3

not now due, never was due, and never will be, to those triumphs of the inventor's mechanical skill, the record of

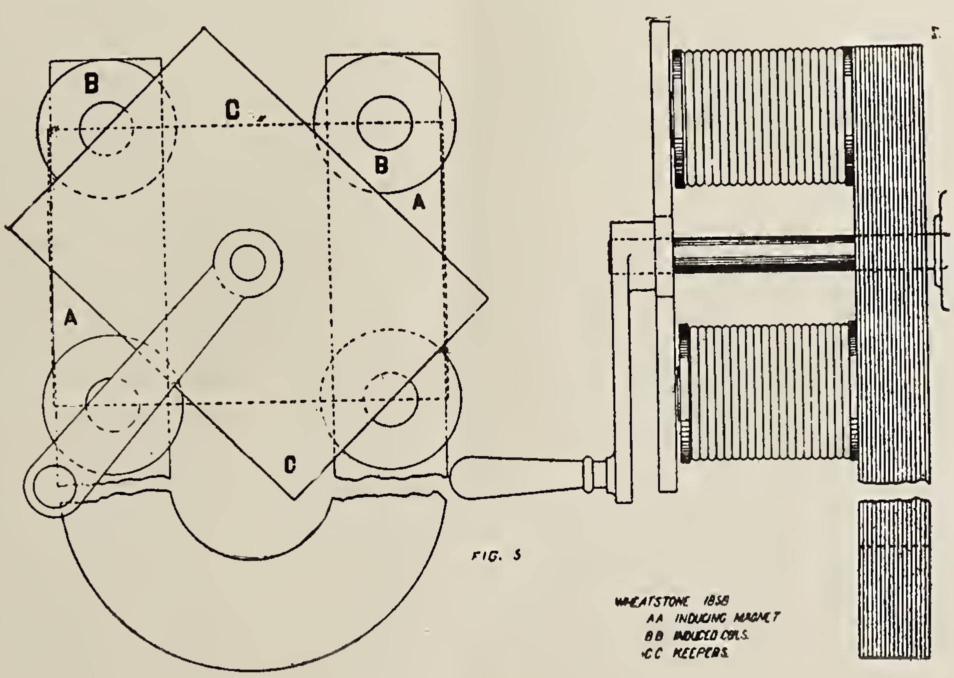


FIG. 5

which forms one of the proudest chapters in the history of the United States.—Scientific American.

The "Baltimore American" says, that the consummation of the extensive plans now in hand on the B. & O. may delay, for some time, the emergence of the road from the hands of the receivers, but when it does come out it will be an up-to-date line in every respect, and one of the most valuable systems in America.

Philadelphia, Pa.—An electric railway between Atlantic City and Camden is proposed by Philadelphia capitalists.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTICAL ENERGY.

BY LOUIS DUNCAN.

THE industrial life of mankind is made up of two things. The transformation and distribution of material and the transformation and distribution of energy. The raw material from mines and forests is changed to finished products and distributed among the people, while energy, obtained from water-power, coal or other sources, is changed from the potential energy of the water or the energy of chemical combination to mechanical power, heat, light, etc. Unless we can transmit this energy economically, we must transform it into the required form at the place where it is to be utilized. At present a large part of our mechanical power is obtained from steam plants situated in the factories themselves, and for heat and light we mainly depend upon stoves and lamps in our houses.

Before the introduction of electrical transmission, it was possible to distribute energy to limited distances by various methods, but no system offered a long distance transmission for all purposes. By means of compressed air or steam pipes the energy of coal has been transmitted to produce mechanical power or for heating, and gas mains have allowed the distribution of gas for lighting or for fuel.

In the case of power obtained from steam plants the economy incidental to large units and a steady load has led to the concentration of industries. Where steam is used the plants are situated where it is most convenient for manufacture. Where water-power is employed it is necessary to bring the factories to the location of the power irrespective of other conditions.

By means of dynamo electric machines, the energy obtained from either coal or water-power may be transformed into electrical energy; may be distributed and then transformed again into mechanical power, light or heat, or may be used for a number of purposes peculiar to this form of energy alone. The limits to the distance of this distribution are imposed by conditions of economy and safety.

It is my purpose to take up the different methods of transmission and distribution and to consider the limits that are actually fixed by the present status of electrical development. The question is a commercial one, each problem presenting different conditions which must be considered, but certain general principles govern each case, and our knowledge and experience make it possible to judge the practicability of each particular transmission.

GENERATING PLANTS.

At the present time practically all of the electrical energy distributed is generated in plants operated either by steam or water-power, and it is important to consider the conditions of maximum economy in large generating plants, as this bears directly on the subject of transmission and distribution.

A large proportion of the electrical plants in this country are steam plants. In the last ten years we have advanced from small stations using high speed dynamos for light and power distribution to large stations, using, as a rule, low speed direct-connected machines. The simple engines that were used some years ago have, in many cases, been changed to compound and even triple-expansion engines, and where it is possible condensers have been employed. Some of the latest plants have machinery of the highest possible efficiency; and yet, if we consider the price per H.P. of the power generated, we will find that it is greater than we expect. This is partly due to the fact that for both lighting and power purposes the load on the station is, as a rule, not uniform and the apparatus is not working under the best conditions for economy. In this country electrical energy is principally generated for electric lighting, for electric traction and for supplying stationary motors; the stationary motors, as a rule, being supplied with current from lighting stations. If we take the load diagram of such stations in large towns, we will find that the average output is not greater than 30 to 40 per cent. of the maximum output. We have, therefore, to supply a large amount of machinery corresponding to the maximum demand on the station, while for distribution a large amount of copper is required that is only being used at its maximum capacity for a comparatively short period of the time. In stations supplying power for traction purposes we find a variation of load, but the variation is a different kind from that found in a lighting station. In the latter the load varies at different hours in the day, but for any particular instant it is practically constant. In the former the average load for different hours during which the station is operated will be practically constant, but there will be momentary variations depending upon the size of the station and the type of traffic. Taking for instance a 2000-H.P. station in Baltimore, I find that the average load is 48 per cent. of the momentary maximum load. The difference in the kind of variation for the two types of stations necessitate employment of different apparatus to obtain the maximum economy for each type. For lighting stations triple-expansion engines may be used, while for traction work, where the variation in the load is sudden and may occur after the steam is cut off from the high pressure cylinder, it is not well in general to go beyond compound engines, and there is even a question as to whether simple engines are not more economical when condensing water cannot be obtained. In any case, however, it is of the utmost importance as regards economy of operation that the load should be made as constant as possible.

Two distinct types of distribution are used for incandescent lighting in this country—the single-phase alternating current and the direct-current three-wire system. At the present time the former does not permit the supplying of power. As alternating distribution is at high potential, it does permit the location of the station where the conditions of maximum economy can be fulfilled. The three-wire incandescent system using low voltages may be used for supplying motors, but the amount of copper necessitated by the low pressure has caused such stations to be located near the centre of distribution irrespective of the best conditions for the economical operation of the plant.

With the alternating system it seems impossible to provide even a moderately steady output, but with the continuous current system the motor load during the day gives an average output greater in proportion to the maximum. Some years ago the question of the relative values of the alternating and direct-current systems was discussed, and for a while most of the stations installed were of the alternating type. At present the tendency seems rather in the direction of continuous current stations, especially in towns where there is a large demand for current within a comparatively small area. There is a great advantage of direct currents in that they allow the employment of storage batteries, which equalizes the load on the station. In almost all of the large lighting plants, both here and abroad, this plan has been adopted to a greater or less extent and the results have been so favorable that the battery equipments in many of our stations are being increased. The efficiency of batteries in lighting stations is comparatively high, while the depreciation has been greatly reduced, and is not now over five or six per cent. per annum. In most systems, however, the full

benefit of the storage batteries is not realized, as the batteries are placed in the station, and while the advantage of an approximately constant load is obtained, yet the further advantage offered in distribution is not secured. I will take this question up later.

(To be continued.)

SYSTEMATIZING ELECTRO-HORTICULTURE.

The Pittsburg Post contains an article of the greatest interest to horticulturists.

"In consequence of the success which has attended the experimental culture of flowers and vegetables by electricity in America, some of the London horticulturists, who desire to be first at Covert Garden with their early salads—a branch of industry which is exceedingly profitable—propose to install the electric light in their forcing houses. In the States, the electric culture of plants for commercial purposes has now become a recognized industry. This fact is mainly owing to the careful compilation of data which has been made by Professor L. H. Bailey, of Cornell University. Professor Bailey shows that the effect of the light is marked even at a distance of 100 feet; that the electric light does not determine the periodicity of growth; that increase under the light occurs only during the first days; that growth takes place in daylight as well as in darkness. His experiments are thus summarized: The influence of the electric arc light upon greenhouse plants is greatly modified by the use of a clear glass globe, or the interposition of a glass roof. Plants which are much injured by a naked light may be benefited by a protected light. The light can be suspended even above the house with good effect. As a rule plants are earlier under the electric light than when grown in ordinary conditions. Lettuce is greatly forced and improved by the electric light. An average of five hours of light per night hastened maturity from a week to ten days, at the distance of from 10 to 12 feet. Even at 40 feet, in only diffused light, the effect was striking. The light appeared to injure young newly transplanted plants. Radishes were also benefited by the light, but not much. To do them any good the light had to be hung outside the house. If placed inside, whether naked or protected by a globe, it injured the radishes. Beets and spinach were apparently somewhat benefited by the light. Cauliflowers grew taller and made fewer and smaller heads; and violets and daisies bloomed earlier in the light house. This corroborates results obtained with other flowers in earlier experiments. The electric light does not appear to determine or modify the hours of growth of lettuce and some other plants which have been studied in this particular. Plants which are benefited simply grow more rapidly during the customary periods. These experiments have been extended over six years, and the conclusions reached are worthy of careful attention as based on independent scientific investigation."

At the joint conference of electrical, insurance and allied interests looking toward the adoption, promulgation and enforcement of a national code of rules for electrical construction and operation, which was held March 18 and 19 of this year at the headquarters of the American Section of Mechanical Engineers, this city, a large amount of work was done, and, after a permanent organization to be known as the "National Conference on Standard Electrical Rules" had been effected, with headquarters at 12 W. 31st street, New York, it was decided to place the work of drafting the final code in the hands of a committee of eight, including the president (ex-officio), who were to report back to the next meeting of the National Conference. This committee consisted of the following gentlemen:

Prof. Francis B. Crocker, chairman, delegate American Institute of Electrical Engineers.

Frank R. Ford, secretary, delegate American Street Railroad Association.

William Brophy, delegate National Electric Light Association.

William H. Merrill, jr., delegate National Board of Fire Underwriters.

E. A. Fitzgerald, delegate Underwriters' National Electrical Association.

Alfred Stone, delegate American Institute of Architects.

E. V. French, delegate American Factory Mutual Insurance Companies.

W. J. Hammer (ex-officio).

This committee have recently met in New York and spent two days upon the preparation of the code and then adjourned to meet again December 11 and 12, this date being decided upon in order to enable the Underwriters' National Electric Association, which meets in this city December 8 and 9, to consider the suggestions already made by the code committee, to secure their criticisms and co-operation in the matter. It is expected that shortly after the next meeting of the code committee that the National Electrical Conference will be called to take action upon the code prepared by the committee.

It is very gratifying to observe that the various engineering societies and the strong representation of the insurance organization, represented in the National Electrical Conference, are working so harmoniously and with so much energy to bring about the long-wished-for and much-to-be-desired single national code of rules.

"Four-Track Series" Etchings. — Eight beautiful etchings, representing scenery along the line of the New York Central, printed from steel plates on plate paper, 24 x 32 inches, are offered for sale at the office of George H. Daniels, general passenger agent, Grand Central Station, New York, at 50 cents each. Art lovers will appreciate this opportunity to secure at nominal cost pictures of high artistic merit, devoid of any objectional advertising feature, and suitable to hang on the wall of any room.

ELECTRIC SOUNDING.

The "Pioneer Press," of St. Paul, makes note of the following interesting fact:

"It is said by the engineers who conducted the laying of the Amazon river cable to Manaos that the difficulties of their enterprise would have been almost insuperable if the ordinary methods of sounding had had to be relied upon. There were no charts to go by, the river bottom was constantly shifting, and the softness of the soil, mostly alluvial clay, would allow the lead to sink into it for several feet. An electric device, fitly named a submarine sentinel, was suspended from the cable ship and set at, say, five fathoms.

So long as there was no signal from the "sentinel" the engineer could steam ahead without fear; but the moment the water became shallower than the gauge fixed upon, the sounder gave an alarm, and special reckonings were taken. A somewhat simpler device, having the same end in view, has been invented, the idea being to have it used as a substitute for the hand lead as a vessel approaches a coast or shoal in darkness or fog, when the captain is doubtful of his bearings. The apparatus consists of a metallic cylinder, having a water-tight chamber. Within the chamber works a piston, upon the outer edge of which is a heavy ball. When the apparatus is swinging clear in the water, the weight of this ball keeps open an electric circuit; but as soon as the sounder touches the bottom the circuit is closed, and the current, conveyed by wires running in the cable by which the sounder is attached to the ship, rings a bell in any department of the ship. The cost of the device is quite moderate, and its inventor claims that its operation is simple and sure.

HINTS FOR WIREMEN.

Wiring is done according to Ohm's law, the resistance of the copper causing a loss or drop of pressure. Ohm's law states that the current flowing in a given resistance increases or decreases as the pressure increases or decreases; likewise that, with the pressure kept constant, the current increases when the resistance is decreased and decreases when the resistance is increased.

This relationship between the current, resistance and electromotive force is expressed as follows:

$$\text{amperes} = \frac{\text{volts.}}{\text{ohms.}}$$

$$C = \frac{\text{E. M. F.}}{\text{R.}}$$

If the resistance is kept steady, the current increases with the volts. For instance, with

ohms = 50
volts = 100,

the amperes are 2; but with volts double, or,

as before, ohms = 50
volts = 200,

the amperes increase to 4.

Drop of Potential, or "drop," as it is commonly called, is calculated by Ohm's law:

Current $\times$ resistance = volts lost.

In the circuit, if the resistance is known and the current flowing through it is measured, the pressure lost in that circuit will increase if either the amperes or ohms increase; that is, if the number of lamps on the line is added to, or if the lamps are not increased, but the length of the line, and therefore its resistance.

To illustrate take a length of wire whose resistance in

ohms = 10,
amperes = 10,

therefore, the drop = $10 \times 10 = 100$ volts.

Reduce the amperes to 5,
The ohms being still 10,

the drop = $10 \times 5 = 50$ volts, or one-half as much.

In all cases of wiring the amount of drop in a wire changes, unless the wire acts as a main, because a feeder is tapped at different points and the current is not the same throughout.

The main carries the total current of any supply system and feeds the feeders.

The resistance of the main is known in the table from its length and size; in wiring about two per cent. is allowed for lost volts; therefore, the main must have a resistance such that the greatest current flowing through it shall not cause more than two volts loss in every hundred.

A feeder that supplies branches with current all along its length need only have a resistance dependent upon the average current it carries. It may have 100 amperes entering and the same leaving at five different points; a portion of the wire carries 100 amperes, 80 amperes, 60, 40 and 20 amperes, successively.

The wire need not be 100-ampere wire, but of about 80 amperes capacity, the main object in view being the fact that the drop is limited to a certain per cent.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—HISSING CARBONS.

Philadelphia, Nov. 28, 1896.

Electrical Age Pub. Co.

Dear Sirs:—In your valuable Inquiry Column I have found the answer to many important questions. I summon up courage once more to ask you whether any explanation exists for the hissing of carbons in arc lamps? Your answer to this question will greatly oblige,

Yours respectfully,
Morris Mann.

(A.)—The hissing of arc light carbons seems to be due to either a hard spot in the carbon or an excess of pressure. It frequently happens that this hissing occurs during the otherwise steady feeding of the carbons and becomes very noticeable with a poor quality of carbons.

(Q.) TIDAL POWER.

San Francisco, Nov. 23, 1896.

Editor of the Electrical Age.

Dear Sir:—The coast of California, it seems to me, should encourage the use of tidal motors. The great amount of power lost each year would be sufficient to drive all the dynamos of the world. A properly constructed raft or swinging series of blades could make use of either the tide or the waves without the expense of fuel or much attention. What do you think of this idea, and is it applicable in a practical way?

Yours very respectfully,
Jasper H. Storey.

(A.)—Power is being neglected that some day will be exclusively used. Tidal motors and wave motors have been in practical use in California for several years Their extensive practical application is apparently limited more, it seems, on account of the imperfection of the machinery employed than the lack of value in the idea. Thousands of horse-power, and we might truthfully say millions, are awaiting useful application. A great field exists for the men of inventive capacity and business tact in this respect.

(Q.)—USE OF STORAGE BATTERIES IN STATION WORK.

Elmira, Nov. 24, 1896.

Editor of the Inquiry Column.

Dear Sir:—The stations are engaged in using storage batteries in many power plants. What I want to know is, whether the batteries are charged during the heavy load and used when the load is light, instead of the machinery, or charged during the light load and *used* when the load is heaviest, in conjunction, of course, with the other machinery? Your answer is awaited with great interest.

Respectfully,
Albert D. Conroy.

(A.)—The storage batteries are charged when the load is light and used when the hour of busiest work approaches. The station can then carry its heaviest load with a smaller plant than is otherwise possible. Storage batteries assist in taking the temporary overload; in reality, the expense of installation of a larger plant or additional machinery is thereby saved.

ZIMDARS & HUNT'S ASSOCIATED EMPLOYEES' BALL.

The evening of December 1, at 11 P. M., over 160 gentlemen, with their wives and ladies, began the grand march at the ball of the organized employees of Messrs. Zimdars & Hunt, the electrical contractors, of 127 Fifth avenue, N. Y., and their friends. After marching around the hall the leader faced the stage and, by a signal, a grand illumination of beautiful electrical effects burst upon the employees and their guests. Mr. John T. Hunt, of the firm, and his friends, were enthusiastic in their praise of the excellence of the electrical display, the work of the employees.

A large gathering of the leading gentlemen in the electrical trade and profession were in attendance. An extended account, giving names of all the attendants and illustrations of the electrical decorations, will appear in our next issue.

The Electrical Age.

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CONTENTS.

EDITORIALS
- X-Rays and the Blind ... 715
- Electricity in Farming ... 715

GENERAL SUBJECTS
- Some Account of the Evolution of the Inductor Alternator ... 709
- Present Status of the Distribution and Transmission of Electrical Energy ... 712
- Hints to Wiremen ... 714
- Ohm's Law ... 722
- The Electric Farmer ... 721

MISCELLANEOUS
- The Man and the Machine ... 711
- Systematizing Electro-Horticulture ... 713
- Electric Sounding ... 713
- Will the Blind Ever See? ... 719

INQUIRY COLUMN ... 714

TRADE ARTICLES
- Railway Appliances ... 716
- Noiseless Launches ... 721
- The Steel Clad World ... 722
- Possible Contracts ... 722
- Telephone Notes ... 723

ELECTRIC STOCK QUOTATIONS ... 723

PATENTS ... 723

X RAYS AND THE BLIND.

Edison has entered into a new field of work; one that promises with its success to class him with such celebrities as Jenner, Pasteur, Morton or Koch. No fame would be more world-wide than Edison's if by his labors the blind could see. The blind, however, the stone-blind, will never see. Absence of vision in man can be traced to the destruction or paralysis of the optic nerve, a disease of the retina or curtain of the eye, or a cataract that completely shuts out the light of day, leaving the retina as well as the optic nerve intact.

The excitation of the sensation of light cannot occur if the nerve is deficient or if the retina is injured. The vision, or, more truly speaking, the image, is thrown through the lens upon the retina. The health of this part with its adjunct, the optic nerve, is essential for image sensations.

X rays may stimulate an inchoate or incipient sensation of light upon a healthy retina. These rays may pass through diseased tissues to reach the retina, but an image of any definite outline can never be seen. X-ray work is essentially shadow work, and whether the shadow is brought into existence by the fluoroscope or any other apparatus the outlines are absent, except in a general and most indefinable manner. The wonder of the work consists in the fact that the blind distinguish—those with partially defunct organs only—the difference between light and darkness.

No channel offers itself for the direction of inventive power that can do much more. Speech, many of the blind possess, therefore it is not likely it will forestall that gift; but in the dumb, the speechless blind, an effort might be made to teach them the language of humanity by means of these dim impressions of shadowy light.

Edison could use the X rays to great advantage with such unfortunates as these.

ELECTRICITY IN FARMING.

The farm is becoming an important centre of electrical machinery. Brush, the famous inventor, has a wind mill and dynamo serving him with light and power at his home in the country. The nearness of farms to water-power has made them the recipients of conveniences that are increasing every day.

Electric plows are not a novelty today. Reapers will also be enveloped with new qualities as the power is introduced further. The most interesting experiment to make is that of forcing crops by means of the electric light. The opposite, in one respect, has been done. The killing of weeds by electricity, such as spring up, for instance, in railway tracks. But the forced growth of plants, etc., in the open air by using the electric light at night makes us wonder whether the prehistoric growths will not be duplicated, especially if the weather is warm and the light powerful.

Plants sleep at night, and it might seem that the lack of it would invite that sad physical condition so noticeable in ourselves. But they are naturally night rounders, and seem to burst into ripeness and bloom with astonishing rapidity under the influences spoken of. The growth of such is not abnormal, but simply rapid. If the farmer had abundantly rich soil he could almost double his crops each year, the profit from which forms a large item in comparison with the expense of evening sunlight. At least the excellence of such an application would have weight with the florist or horticulturist. Before the Easter day reaches us he could encourage the growth of those flowers which sell freely, and thus prepare himself for the inevitable demand which exists about that time.

Agricultural and horticultural work may in the future be greatly advanced by the application of electricity.

A pretty application of electricity has been made in in the photography of instantaneous splashes. The pictures were taken each with an electric spark, giving an exposure less than .000001 of a second. The spark could be so timed as to pick out any desired stage of the splash within limits of error not exceeding, as a rule, about .00002 of a second. In this way the progress of a great variety of splashes has been followed in detail. Among the points specially illustrated were the formation of bubbles, and the manner in which the condition of the surface affected the disturbance produced by the entrance of a solid sphere.—Progress of the World.

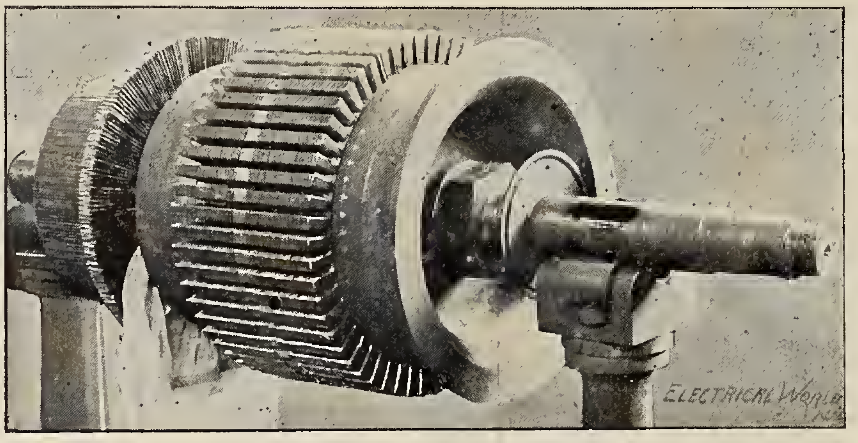
Montreal, Que.—According to the promise of the managing director of the Montreal Street Railway Company,that work would commence on the Centre street and Cote des Neiges road route after the close of the exhibition, a start was made. A gang of about twenty men were set to work on Guy street, starting from St. James. If the line is to be completed before December 1, the company will have to increase their force of laborers considerably as the council does not appear disposed to stand any more dilly-dallying in the matter.——The Park and Island Railway Company is making rapid progress in the construction of the extension to Lachine, and it is expected to have the line through before snow flies. The track between the city limits and Rockfield is about laid and the grading is completed as far as the Dominion Bridge Works. The line to St. Laurent is now open and running. The work on the new power houses, located at Lachine and St. Laurent, is progressing; it is expected that both will be ready to turn the power on this autmun.

J. Alcide Chausse.

RAILWAY APPLIANCES.

The great art of the present age is to meet the popular demand promptly and with low prices.

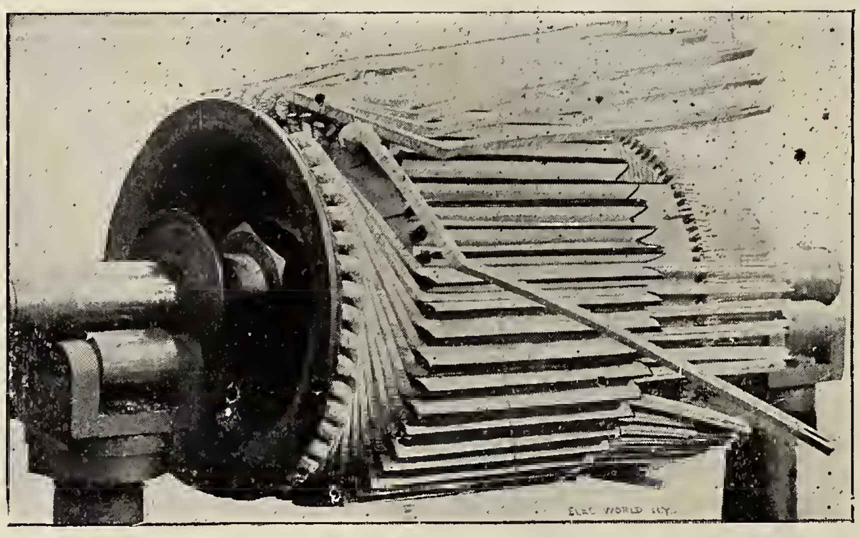
The many corporations that have this fact in view have succeeded.



View Showing End Disc.

Men of experience and skill are required to meet the demand with readiness and they must be of infallible instinct to herald its coming, or, as we say, create it.

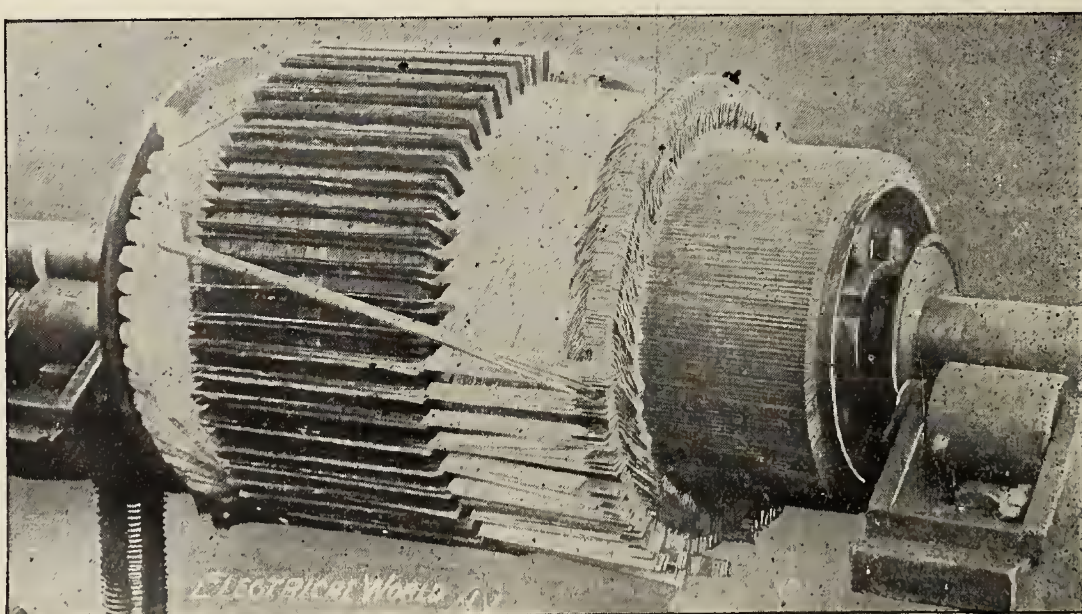
In the design and manufacture of railway appliances



Armature Winding.

the various companies have vied with each other in this respect.

This has had the effect of improving to an extraordinary degree the apparatus used and the systems employed.



Armature Winding.

The Walker Company, of Cleveland, Ohio, is the only independent manufacturer of street railway apparatus. It is the successor to the Walker Manufacturing Company, which in 1883 was organized to carry on a general foundry and machine shop business.

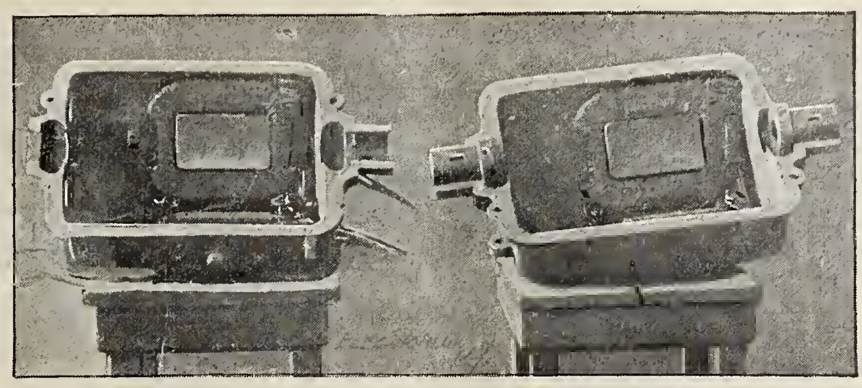
It began, therefore, with a full knowledge of the requirements of machine shop practice, with men of experience and ability, and a thorough appreciation of the labor and skill necessary to effect the successful production of high class machinery.

The company has built a host of railway and lighting generators, comprising at least twenty-two different sizes, and about five sizes of railway motors, there being at present a sixth in the process of construction. The illustrations show the general principle employedin mounting motors on trucks, the springiness and method of suspension entirely relieving the truck from jolts or blows.

A general view of the variety of sizes is displayed in another illustration, which the reader will appreciate as showing the general design and range of the Walker Company's work.

A pair of illustrations of greater detail, clearly indicat-

ing the iron-clad construction, solid fitting and relative position of pinion and axle, are shown in addition.



Field Pieces of Railway Motor.

Two designs that have all the characteristics of the Walker shops are thus compared.

The winding of the armature is laid bare, so that the compactness and perfect fit of each wire may be seen. The Walker Company do not believe in having a shapeless wad at the armature extremity, or a place which encourages burn-outs and bugs. Each wire, as shown, packs symmetrically in place both electrically and mechanically.

The style employed is lap-winding; the conductors in each slot are taped and form one coil. The lead of the coil is arranged to suit the brush-holder and style of machine. One of their windings for generators has coils composed of five strips, which may be used for either 110 volts and heavy current or 550 volts and one-fifth the current.

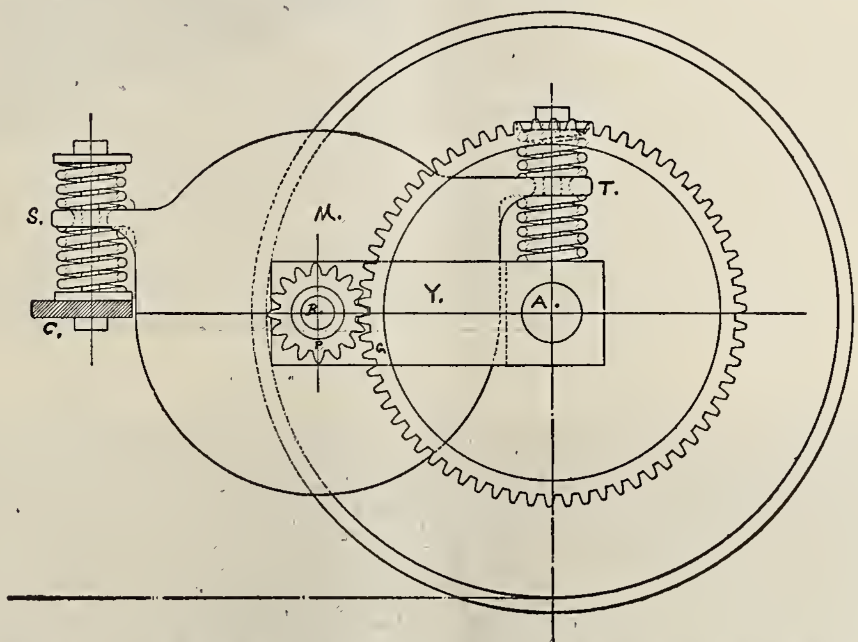
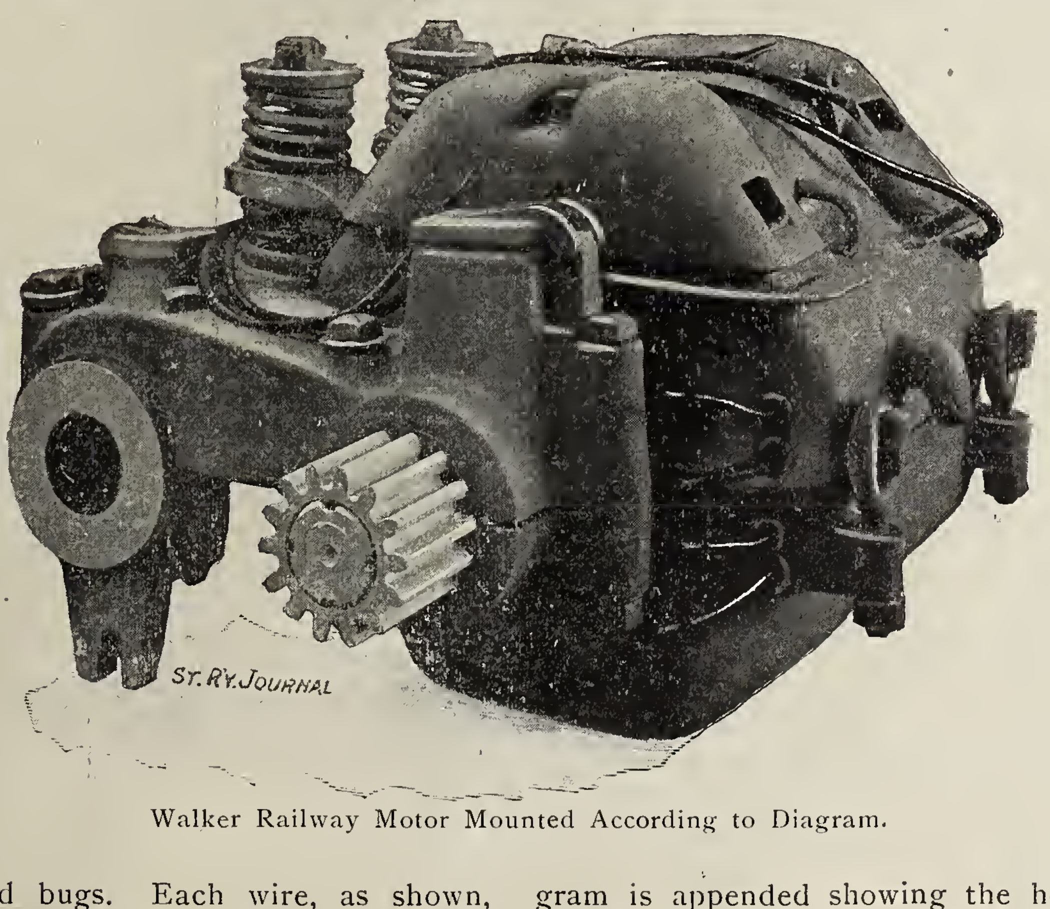
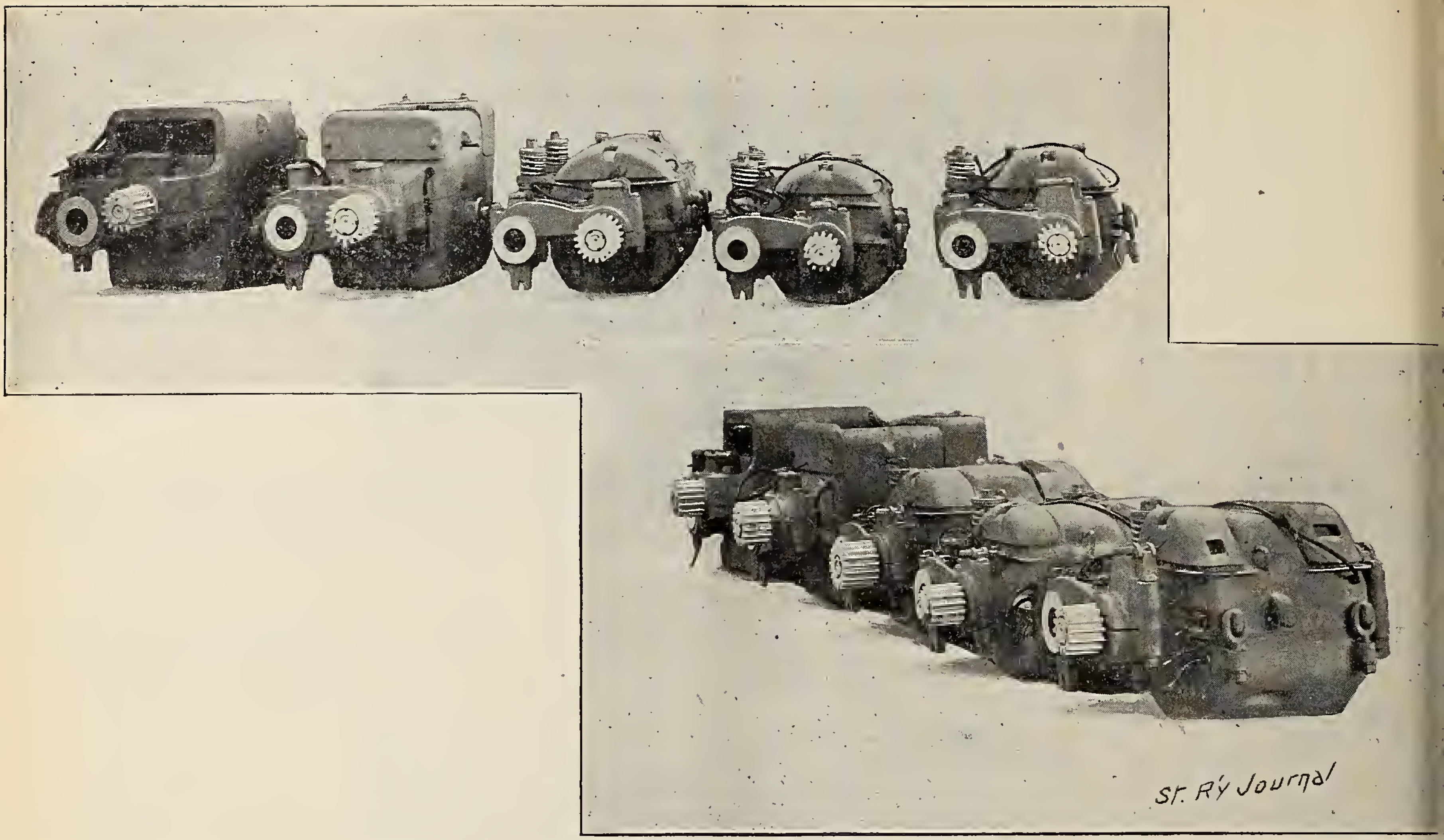


Diagram Showing Method of Mounting the Walker Railway Motor.

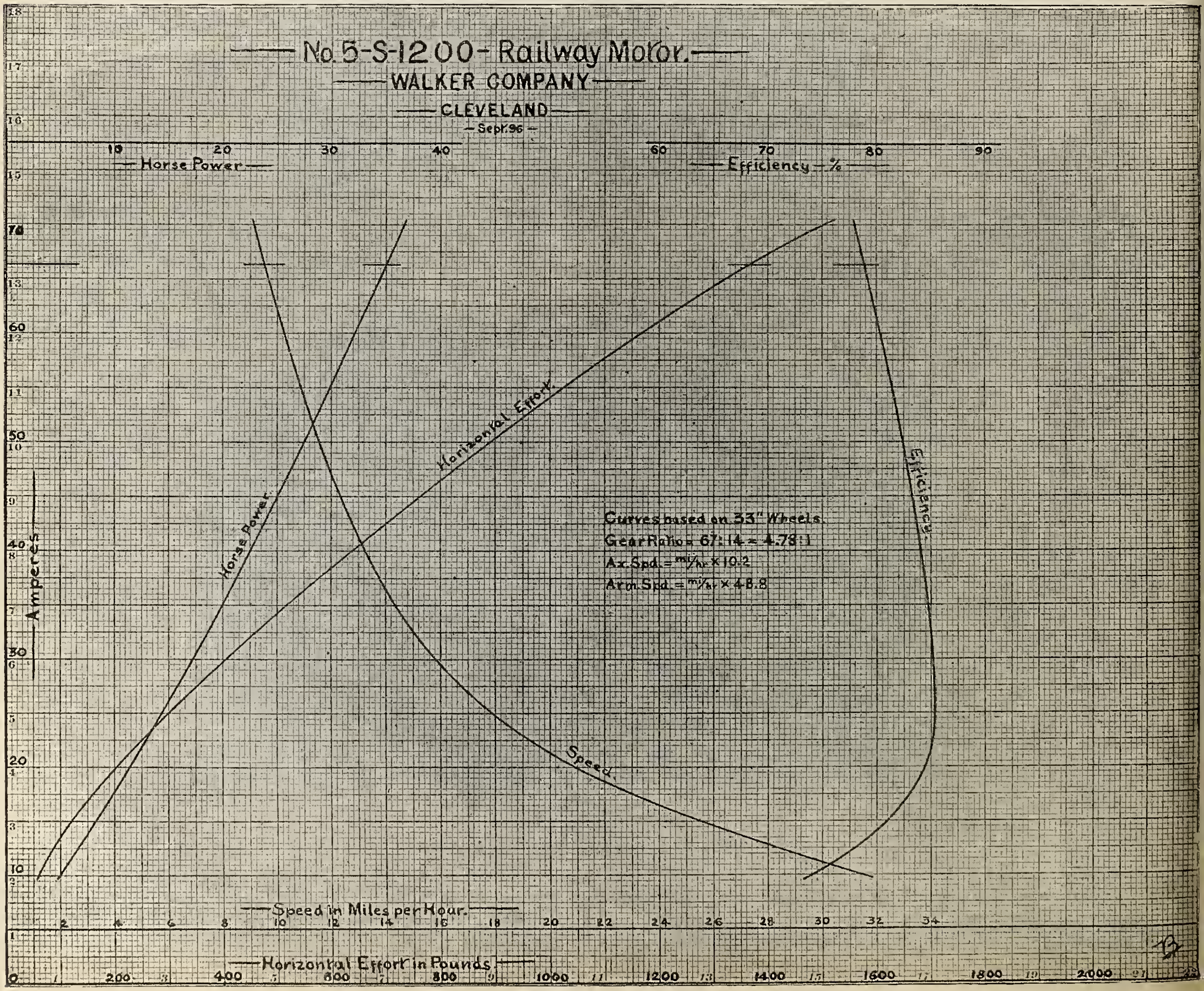
The field pieces of a railway motor are likewise displayed in position, insulated and connected up. A diagram is appended showing the horse-power, horizontal effort, efficiency and speed of a Walker railway motor according to test.



Walker Railway Motor Mounted According to Diagram.



Walker Railway Motors.



WILL THE BLIND EVER SEE?

The present contention regarding the possibility of restoring in part the sight of the blind resolves itself into a definite series of statements which the N. Y. "Journal" of November 29, 1896, published, having received communications from Thos. A. Edison and certain medical authorities.

Edison tried the X rays on a little Newark girl and she distinguished shadows. Edison states as follows:

"The Roentgen ray may give just the vibration which will affect her eyes, while that of ordinary light may not influence them. A lot of work must be done before the full possibilities of the Roentgen ray in affecting the eyes of those who have been blind will be known. The thing is yet in its crudest stage, but there is no doubt that the Roentgen ray makes an impression on people who have been blind, and that under certain circumstances it enables them to see."

Professor Wright, of Yale University, remarks:

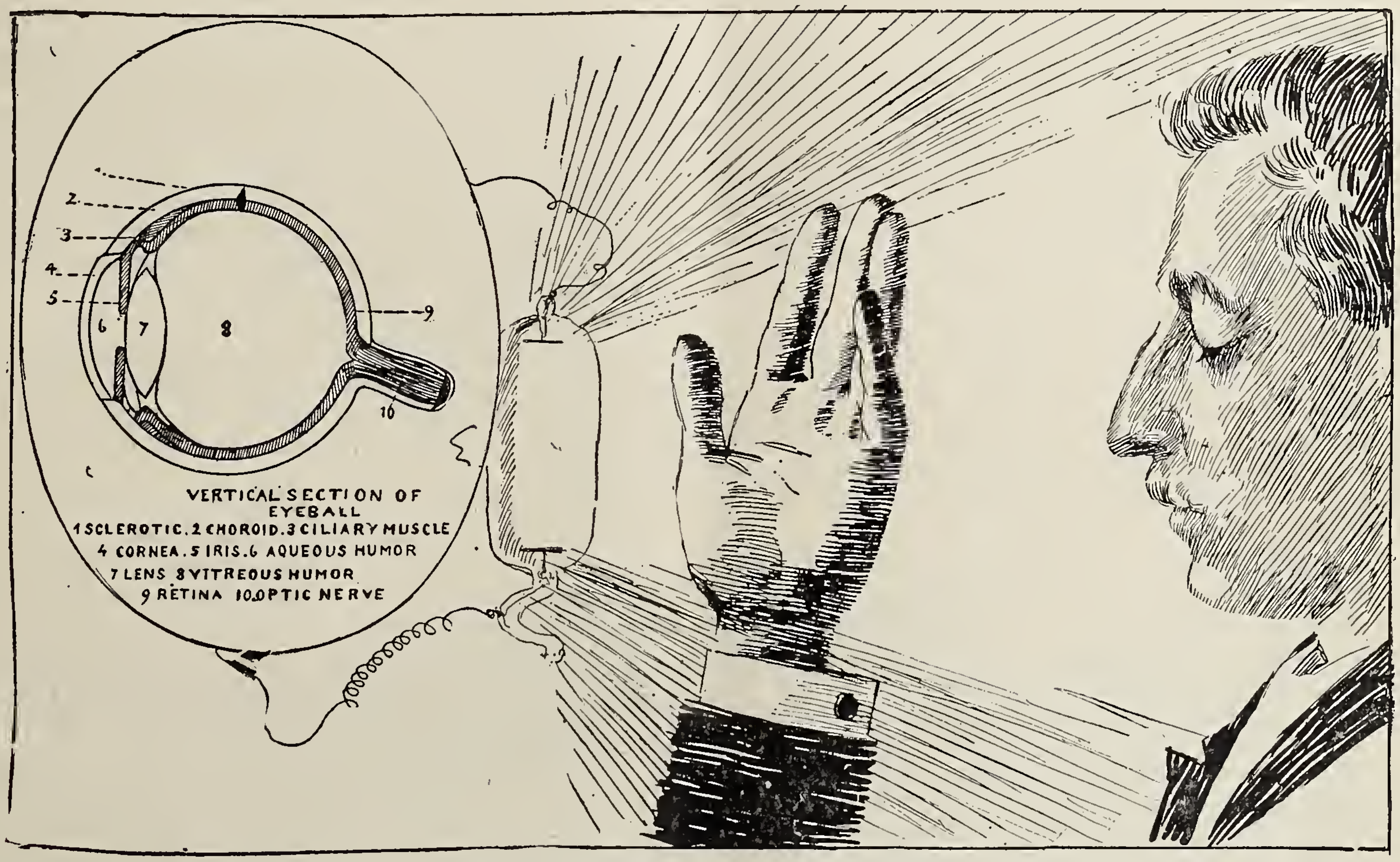
"I see no reason why the X ray should not be advantageously employed in aiding the blind. The rays are known to have a peculiarly sensitive effect upon the skin, and I see no reason why they might not so stimulate the retina of the eyes of the blind that, at least, temporary sight might be restored. Whether this sight could be made permanent is a matter of conjecture. Personally, I have not experimented in that direction, and can only give my impressions, derived from what I have read and learned of the experiments of others. There are great possibilities yet unknown in this mysterious light, and the restoration of sight to the blind is not among the least improbable of its results."

And Prof. Alexander Graham Bell, Washington, D. C.:

"The reported discovery of the sensitiveness of the closed eye to Roentgen rays is important if true. With our present knowledge it is impracticable to focus the rays by refraction or reflection, to produce an image in the eye. The rays transmitted through a fine hole in a screen should form an image analogous to a pin-hole photograph, but this would be an image of the excited tube, and no power of seeing other things need be expected until rays can be produced capable of reflection from an ordinary object. An X-ray lantern may be among the possibilities, but we have not got it yet. Experiments had best be left to physicians and oculists."

An eye-witness of Dr. Morton's experiments speaks as follows:

"I was present when Dr. William J. Morton, of No. 19 East Twenty-eighth street, performed an experiment upon Miss Rodney, an elderly lady, who was entirely blind and was sent from the New York Institute for the Blind, as well as upon Armin Schotte and Gustav Kaufman. We got fairly good results in the case of Schotte after his eyes had been subjected to a prolonged bath of Roentgen rays. He saw the light distinctly and could distinguish coins nailed to a piece of board. The retina of his left eye was evidently untouched by disease, whereas the retinæ of the other subjects were evidently atrophied and inoperative. Dr. Morton and I tried experiments upon ourselves. Closing our eyelids tightly and shutting off the tube by the intervention of a piece of cardboard, we were able to tell when a square piece of iron was interposed between the cardboard and the Crookes tube. This showed that the X rays stimulate the retina."



Method of Testing For Sight With X-Rays.

The cut, showing the general nature of the experiments with sightless unfortunates, invites these ultimate conclusions.

Without a *retina* sight of any description is impossible, as Dr. Jeffreys, of Boston, states: "The optic nerve is not an organ of sight, or a medium of sight, but simply transfers to the brain the results of sight, and if it were possible to 'excite it,' it could not convey a sensation of light." The mere cloudy impression of the presence and absence of light is, though wonderful to those living in perpetual night, not of any practical benefit. The discernment of outlines would be the true victory, but a retina is in any case indispensable.

Goderich, Ont.—The town have awarded The Rogers Electrical Company, of London, the contract for the installation of five hundred incandescent lamps.

Toronto Junction, Ont.—Joseph Barrett has made a proposition to take over the lighting plant and furnish light to the town. In connection therewith, there is a project to erect a large factory at the corner of Keele and Vine streets.

OHM'S LAW.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Each branch of science seems to rest upon the foundation of some great law.

Mechanics has its Newtonian law of gravitation; astronomy, a derivative science, owes its existence to the laws of planetary motion, Kepler's laws; and in common with these we pass to the great science of the day, which depends for the explanation of its many phenomena upon Ohm's law.

A little pamphlet written by Dr. G. S. Ohm, in Berlin, in 1827, called "The Galvanic Circuit Mathematically Investigated," came to light before the scientific societies of Germany and England. Previous to Ohm's work it was a very difficult matter to speak definitely of the qualities possessed by an electric current except in a manner that gave no valuation either to the current or pressure.

Let us return to the main subject and try to discover whether a current of electricity can be examined intelligently as to its changes in strength and pressure.

A current of electricity is a natural phenomenon. A blast of steam passing through a pipe, or a stream of water under the same conditions, takes the path offered—that is, the pipe—and moves through it delivering a quantity at the other end, dependent upon—

(1) The pressure of the steam or water.
(2) The diameter and length of the pipe.

This illustration serves to show that a fluid or gas is affected in a manner that can be considered as a matter of daily experience, when the dimensions of the pipe are increased or decreased, or when the pressure within the pipe is likewise changed.

A current of electricity seems to possess modes of action that correspond somewhat to the passage of a fluid through a pipe. The difficulty in using this simile, however, is the false impression that may be conveyed, that electricity is *itself a fluid.* Electricity is no more a fluid than heat or light, or even magnetism. Its behavior under certain conditions, though, has been best understood by a comparison of this kind. Let us send a current of electricity through a wire. It is highly evident that the electrical impulse will not pass through the wire unless it is forced to do so. There must be some definite reason for its movement, otherwise it might happen, if there were not, that it would not pass on a given occasion. We find, therefore, that the current from a battery or any other source of electricity is brought into being and is, in fact, only able to manifest itself because it possesses a quality that enables it to pass from point to point and makes it an active source of power.

What is this quality without which the phenomenon of electricity could not exist, without which the current could not leave the battery, and without which it would remain immovable in a line of wire?

Electromotive force is the expression used to describe this quality. It is roughly comparable to the pressure in a boiler, which forces the steam along, or to the pressure in a hydrant, that forces the water out. The pressure of the water is due to a *difference of level* between the faucet and the water in the reservoir; the pressure is therefore a *consequence* of these two levels.

A current from a battery is originally started by the electromotive force within the cell.

This establishes a difference of pressure between the elements of the cell—the zinc and copper, or the zinc and carbon. They act towards each other like bodies of water at different levels. One element has a tendency to send its electricity into the other element simply because its *electrical level* is higher. The word level might be changed to the word *potential*, and the difference of electrical level between the elements in a cell spoken of as the *difference of potential* between the elements of a cell. The chemical action brings the electromotive force into existence, which in its turn causes, by its lack of balance between the elements, a difference of pressure, level or *potential.* A current flows because a difference of electrical pressure instantly transmits the electrical energy from point to point, only from a point of higher to one of lower potential.

If inequalities of potential cause a flow of electricity, how shall we know how much passes or how to regulate it? The current traverses a wire; it is forced along the wire because one end of the wire is at a lower potential than the other. If the wire is of such a metal that a current has difficulty in getting through it, only a little will pass; in order to get more through, the difference of pressure or potential between the ends must be increased.

The case would be like that of a narrow steam-pipe through which at one hundred pounds pressure an attempt is made to force a great quantity of steam. It will not pass through unless the pressure is doubled, tripled or, it may be, quadrupled.

The wire opposing the flow of current is said to possess resistance. All metals resist the passage of electricity to a greater or less degree. They all have *resistance*, and to send the same value of current through equal lengths and diameters of each would require different electric pressures.

The unit of electromotive force is called a volt.

The unit of resistance is called an ohm.

A gravity battery produces about one volt; a cell of this general description having given the original value, since then slightly changed.

The resistance of a column of mercury 106.3 centimeters long ( ), whose weight equals 14.4521 grammes ( ), and of equal cross-section throughout, is exactly one standard ohm.

A pressure of one volt will force through a column of mercury like the above—that is, one ohm—a current whose strength would be one ampere.

An ampere is the current delivered through a resistance of one ohm by a pressure of one volt.

Ohm's law merely states this fact as follows:

$$\text{Current in amperes} = \frac{\text{Pressure in volts.}}{\text{Resistance in ohms.}}$$

For example, with 100 volts
at 10 ohms,
what current is delivered?

$$\text{Current} = \frac{100}{10} = 10 \text{ amperes.}$$

Another way of stating Ohm's law is as follows:

Ohm's Law.—The current is directly proportional to the electromotive force and inversely proportional to the resistance.

Consolidated Electric Supply Co., 99 Nassau street, is the title of the new company organized November 10, by Mr. H. Mays and F. Rall, both gentlemen well known to the trade. Mr. Mays was with the Wilmington City Railway Co. for five years. They carry a stock of all kinds of electrical goods. Their specialty is Consolidated Tube Co.'s tubes, in brass and iron. They are furnishing all the supplies for Camden, N. J., Armory for 1,100-lamp plant and 700 flash burners.

THE ELECTRIC FARMER.

Our electric farmer tells us that there is no reason why we should not have a comprehensive electric farm at once, as already there are electric plows, harrows, rakes, reapers, threshing machines, sheap-shearing machines, sod rollers, cultivators, fence makers, etc., and all that is now needed is to get them together and set them to work. Of course power is necessary for generating electricity, but that can easily be obtained by the "electrical utilization of wind mills, the tides of rivers and the flow of artesian wells." Says he: "There are 1,000,000 wind mills in operation in this country at this time. Every one of these mills can be adapted to the generation of electric power for farm purposes." And he points for example to the plant of Prof. Brush at Cleveland, O., whose residence is lighted by electricity, the current being obtained primarily from a wind mill. (This plant cost over $40,000.) He informs us also that the tide of the river near Chicago is being now utilized to generate the necessary power by a "pontoon carrying a number of large paddle wheels which are revolved by the action of the current." We are not informed on which branch of the river it is located, but on either a machine for utilizing the strength of the smell would give more power than the current. It is true a device or apparatus of this character is made in Chicago that works successfully; its time, however, is not wasted on the rivers hereabouts. And Chicago has also an electric plow that is doing wonderful work according to the same authority. But, though we are making such progress in electric farming in this country, they are beating us in Europe. At some place in France a farmer has obtained a current of about thirty horse-power from a neighboring waterfall to run his plow, at a cost of $5,000, and the surrounding farmers are all going in for electricity. Enough of this nonsense. Electric farming under present conditions is about as practical as balloon farming. Farm machinery may be run by a balloon, but that does not prove that it can be thus done successfully and acceptably. No doubt electricity will be used to operate fixed machinery on some farms where the current can be obtained readily and cheaply, and wind mills may be utilized to some extent in electric lighting; but the era of electric farming is far ahead.—Farm Implement News.

NOISELESS LAUNCHES.

The Daimler Motor Co., of Steinway, Long Island City, build beautiful launches which are run by their kerosene motors.

No smokestack is required, and the launch driven by the motor is one of the cleanest and fastest made. A small dynamo driven by their improved motor would supply a search light for signalling and incandescent lights within.

The reversing gear is so arranged that the motor need not be stopped when the boat is. No licensed engineer is required and the shallowest water permits their use.

Dalmler 53-Foot Twin Screw Yacht.

These elegant launches are made from 16 to 100 feet in length with from one to twenty-five H.-P. on board.

Being noiseless they will prove excellent to sportsmen in approaching winged game. The launches on hand are made with either an open deck or a cabin.

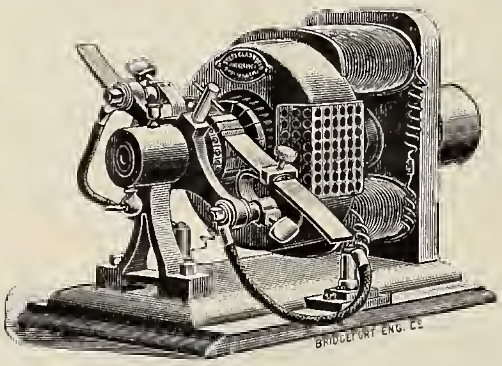
The Dynamo Electric Maintenance Co., No. 180 Sumner street, Boston, undertake to keep both dynamo and motor free from faults, such as may not be apt to receive the proper attendance during service. We reccommend them to the public.

C. T. Leland, of Quakertown, Pa., is erecting a water and electric light plant at Delaware City, New Castle County, Del. The above includes a brick building with a tin roof, water-pipes, mains, couplings, electrical work, etc.

THE STEEL-CLAD WORLD DYNAMO.

The Arnoux & Hochhausen Electric Co., of 478–480 Pearl street, N. Y., build "The Steel-clad World" plating dynamo. Its capacity is 100 gallons for all metals and its current is 75 amperes at five volts pressure. The armature is Gramme wound, the field bipolar, and the commutator large and substantially built. Enough surface has been provided to give good radiation, and the bearings will remain in excellent condition, being well aligned.

The machine runs free, does not heat and delivers its current without sparking or any other difficulty. The brush-holder is springy and well made. Its current-carrying capacity is sufficient, and the rocker arm well fitted and solid. "The Steel-clad World" is a jeweler's dynamo for coloring and removing fire from silver and gold. No. 1, price $100; No. 2 costs $200. The "World dynamo," another type they sell of Boissier's new improved design for depositing nickel, brass, copper, gold and silver, is sold by Arnoux & Hochhausen. The sizes are Nos. 1, 2, 3, 4, ranging in capacity from 400, 1,000, 3,000 to 5,000 gallons. Write for further particulars.


The Steel Clad World Dynamo.

"America's Greatest Railroad."—The traveller who enters a New York Central train at Grand Central Station, and keeps his eyes open as he speeds out across the Harlem, and along the banks of the noble Hudson, and is whirled away toward the West, cannot fail to be impressed, first, with the comfort and elegance of his surroundings; second, with the grandeur of the scenery viewed from the car windows and, finally, with the physical superiority of a railroad that can run hundreds of miles without a jolt or jar, and on so exact a schedule that it is said the officials of a town in Western New York have for years set their watches every day by the time of a certain train.

BENJAMIN R. WESTERN.

The Manufacturers' Advertising Bureau, 126 Liberty street, New York City, was established in 1879 by its present head and proprietor, Benj. R. Western, who had previously been actively identified with trade journalism in the publication of the "Engineering and Mining Journal," the "Manufacturer and Builder" and "Coal and Iron Record," all of New York.

Mr. Western has built up a large business with the bureau in the management of firms' advertising and newspaper work, and the frequent additions to his list of clients bears out the claims of the concern that it can handle this department of a manufacturer's business to the best advantage.

The Manufacturers' Advertising Bureau deals almost wholly with the trade journals, making a specialty of this class of mediums, regarding which it is quoted as an authority.

A booklet with the title "Advertising for Profit," tells how it works, and will be sent to any of our readers without cost upon application.


Benjamin R. Western.

POSSIBLE CONTRACTS.

Washingtonville, N. Y. — Electric lights are being talked of in this town.

Brooklyn, N. Y.—Officials of the Long Island Railroad are considering the feasibility of adopting electricity as a motive power on some of its branches.

Ballston Spa, N. Y.—The Ballston Electric Light and Power Company have decided to double the capacity of their plant. They will add a 200 horse-power boiler and engine and a 2,000-light dynamo.

Geneva, N. Y.—The village wants an electric light plant.

York Haven, Pa.—One of the largest electric plants in

this country is to be established at York Haven at a cost of $2,000,000. The enterprise will be under the supervision of H. L. Carter, Mr. Severy and Mr. Einstein, of New York. The plant will distribute a current of electricity throughout the nearby towns, such as Harrisburg, Lancaster, York, Manchester and all towns with a radius of thirty or forty miles.

Hartford, Ct.—An electric road from Torrington to Winsted is projected. A committee, with O. R. Fyler as chairman, will ask the next legislature for a charter.

Paola, Fla.—R. G. Blake, city clerk, will receive bids and proposals at once for an electric light plant. The plans and specifications are to be prepared by the Royal Electric Company, of Peoria, Ill.

Egg Harbor City, N. J.—A franchise for the erection of an electric light and power plant was given Messrs. Green and Siggons, of Philadelphia.

Newark, N. J.—The Market Committee is considering the advisability of erecting an independent plant for lighting the market. Satisfactory results have been secured, showing that it was possible to get more light for less money by means of a private plant.

Bridgeport, Ct.—The Bryant Electric Company have determined to establish a branch of their business in Chicago, in order to compete for western trade. The main factory will continue to remain in this city.

New Rochelle, N. Y.—A franchise has been granted to the Larchmont Electric Company for lighting the village. Work will be begun at once.

Philadelphia, Pa.—Drawings have been finished for car-house, shed and stables for the Camden and Suburban Railroad Company. There will be repair shops with the latest improved electrical appliances, such as drills, etc. The operation will cost about $100,000.

Washington, D. C.—Electric light plant. The United States Electric Lighting Co. will expend $300,000 during the coming year for additional machinery and other improvements.

Some months ago the B. & O. R. R. inaugurated a fast freight service from New York to Chicago and St. Louis. This train immediately became very popular for shippers, and as extra attention was paid to it, business became so heavy that it is now run in two sections. The practice of running freight trains on passenger schedule time is becoming quite popular with the trunk lines.

TELEPHONE NOTES.

Oakland, Md.—A telephone company has been organized at Friendsville, Garrett County, which will shortly commence the erection of a line from that point by the way of Accident, Hoyes, McHenry, Thayerville, and thence to Oakland.

Crisfield, Md.—The Standard Telephone Company has been engaged in stringing wires from the central office to Asbury. It is the intention of the company to connect all the towns of the Eastern Shore with Baltimore.

Philadelphia, Pa.—The Cecil Telephone Co. has been sold at an assignee's sale for $600.00 to R. C. Lewis, of Elkton.

Camden, N. J.—The Camden Telephone Co. is trying to get a franchise from the city council to construct telephone lines through Camden.

Mechanicsburg, Pa.—Efforts are being made in Mechanicsburg to establish a telephone exchange.

Harrisburg, Pa.—A charter has been issued by the State Department to the Kiskiminetas Valley Telephone Company, Apollo, to build a system of telephone lines through Armstrong and Westmoreland counties. Capital, $2,000. Directors, C. W. Bollinger, Apollo; Ira C. Ewing, Aronmore; W. H. Ewing, Saltsburg.

Augusta, Ga.—A company has been organized to establish a telephone system. Capital stock, $25,000. J. P. Verderey, president, and J. H. Jackson, manager.

St. Louis, Mo.—The Wagner Electric Mannfacturing Company has filed articles to increase its capital stock from $100,000 to $250,000. The assets are given as $187,327,67 and the liabilities $60,934.48.

ELECTRIC STOCK QUOTATIONS

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
Edison Elec. Illg. Co., New York,	99	101
Edison Elec. Illg. Co., Brooklyn,	98	101
Edison Ore Milling Co.,	—	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft .Wayne Elec. Co. T. Sec. Series A,	2½	4
General Electric Company,	30½	31½
General Electric Company pf.,	70	75
Hartford (Conn.) Lt. & Power Co.,	—	20
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81	83
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse Elec. & Mfg. Co.,	26	28
Westinghouse El. & Mfg. Co., pf.,	50	51
Westinghouse El. & Mfg. Co., assd.,	—	28

*Ex dividend.

Grand Central Station, New York.—Entering or leaving New York by the New York Central, the traveller will appreciate the convenience of Grand Central Station, Fourth avenue and 42d street, which is in the very centre of the hotel, residence and theatre district, and the point from which all principal lines of elevated and surface cars radiate. The New York Central is the only trunk line whose trains enter the city of New York.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued September 29, 1896.

Copies of any patent will be forwarded on receipt of 10 cents each.

568,335. Signal Box. Charles W. Cornell, East Orange, N. J. Filed December 5, 1895.

568,346. Telephone Mechanism. John L. Givin, Stony Point, N. Y. Filed December 6, 1894.

568,350. Alternating Current Electric Motor. Fred S. Hunting, Fort Wayne, Ind. Filed August 31, 1892.

568,370. Electric Alarm for Steam Gauges. Albert Ransom and Andrew J. Corrothers, Wise, W. Va. Filed January 25, 1896.

568,413. Brush Holder. Sidney H. Short, Cleveland, Ohio. Filed October 29, 1895.

568,414. Armature Winding. Sidney H. Short, Cleveland, Ohio. Filed April 20, 1896.

568,415. Flat Winding for Armatures. Sidney H. Short, Cleveland, Ohio. Filed May 4, 1896.

568,423. Annunciator. Clarence E. Beach, Binghamton, N. Y. Filed August 16, 1895.

568,444. Electric Weather Indicator. Wallace M. Kelch, Dayton, Ohio. Filed November 21, 1894.

568,447. Secondary Battery. Frank King, London, England. Filed April 10, 1896.

568,450. Electric Switch. John E. Meek, New York, N. Y. Filed March 20, 1896.

568,451. Electric Thermostat. John E. Meek, New York, N. Y. Filed May 29, 1896.

568,452. Trolley Wire Support. William A. McCallum, Cincinnati, Ohio. Filed March 2, 1896.

568,458. Tandem Parallel Controller for Induction Motors. William B. Potter and Frank E. Case, Schenectady, N. Y. Filed August 31, 1895.

568,459. Extinguishing Electric Arcs. William B. Potter, Schenectady, N. Y. Filed June 20, 1896.

568,464. Constant Potential Alternating Generator. Charles P. Steinmetz, Schenectady, N. Y. Filed April 30, 1894.

568,475. Synchronizing Device for Electric Clocks. William J. Cruyt, Brussels, Belgium. Filed January 7, 1895. Patented in England March 17, 1894.

568,493. Automatically Testing Fire Alarm Circuits Lewis G. Rowand, Camden, N. J. Filed August 2, 1895.

568,494. Electric Fire Alarm Circuit and Signal Box. Lewis G. Rowand, Camden, N. J. Filed August 8. 1895.

568,495. Fire Alarm Circuit. Lewis G. Rowand, Camden, N. J. Filed August 13, 1895.

568,513. Telegraph Receiver. Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. Filed May 11, 1896.

568,514. Perforator and Circuit Controlling Apparatus Therefor. Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. Filed May 11, 1896.

568,516. Perforator. Charles L. Buckingham, New York, and Joseph Gardan and Emil Germann, Brooklyn, N. Y. Filed May 11, 1896.

568,523. Trolley System for Electric Railways. Charles E. Davis, Chicago, Ill. Filed April 27, 1986.

568,526. Substance for Telephone Electrodes. Daniel Drawbaugh, Eberly's Mill, Pa. Filed January 10, 1896.

568,527. Telegraph Sounder. David M. Dunn, Abingdon, Va. Filed January 27, 1896.

568,566. Construction and Operation of Circuits for Electric Motors. Frank E. Herdman, Winnetka, Ill. Filed June 21, 1895.

568,567. Electric Elevator. Frank E. Herdman, Winnetka, Ill. Filed October 5, 1895.

568,568. Elevator Motor Controlling Device. Frank E. Herdman, Winnetka, Ill. Filed October 5, 1895.

568,569. Brake Mechanism for Electric Elevators. Frank E. Herdman, Winnetka, Ill. Filed October 5, 1895.

568,570. Brake Mechanism for Electric Elevators. Frank E. Herdman, Winnetka, Ill. Filed October 5, 1895.

568,571. Brake Mechanism for Electric Elevators. Frank E. Herdman, Winnetka, Ill. Filed October 5, 1895.

568,577. Automatic Switch Arm for Telephone Receivers. Hugo Marcuse, Berlin, Germany. Filed January 7, 1896.

568,606. Electric Signaling Apparatus. Adolph Garing, Carlstadt, N. J. Filed April 21, 1896.

568,608. Alarm Device for Electric Motors. Walter A. Gibbs, Pawtucket, R. I. Filed December 14, 1895.

568,644. Signaling System for Railways. Frederick C. Timpson and Ransom F. Rankin, Philadelphia, Pa. Filed December 14, 1895.

568,650. Electric Track Circuit Rail Joint. George H. Williams, Fort Smith, Ark. Filed March 18, 1896.

568,668. Electric Bell. Foriest Davey, Detroit, Mich. Filed February 17, 1896.

568,675. Telegraphy. Rupert Greville-Williams, Heywood, England. Filed October 5, 1895. Patented in England August 1, 1894.

568,682. Electro-magnetic Adhesive Device. Albert A. Honey, Tacoma, Wash. Filed January 25, 1896.

568,683. Insulating Compound. Louis Honig, St. Louis, Mo. Filed June 24, 1896.

568,713. Rail Bond for Electric Railways. Charles C. Benson, Covington, Ky. Filed December 1, 1894.

568,720. Roentgen Ray Exhibition Apparatus. Arthur A. Hamerschlag, New York, N. Y. Filed May 20, 1896.

568,721. Electric Arc Lamp. William Jandus, Cleveland, Ohio. Filed March 5, 1896.

The Electrical Age.

VOL. XVIII., No. 24. NEW YORK, DECEMBER 12, 1896. WHOLE No. 450

The New Electric Cars.

GREATER NEW YORK JOINED BY ELECTRIC CARS.

The trains on the Brooklyn Bridge are now entirely operated by electricity and the noisy, puffing, little steam locomotives in use since the first train was hauled across the bridge have been at last discarded. The change was effected on November 30, when twelve motor cars were put into service, operating the trains in conjunction with the cables more quickly, quietly and more satisfactorily than the steam motor. Fourteen motor cars are now in service, and the remaining six car equipments are being installed as rapidly as possible, to be put into service as soon as completed.

The motor cars do not differ outwardly from the regular passenger cars, except that the platforms are three inches longer. The length of the car is forty-five feet over all, and weighs about twelve tons more than the ordinary car. The total weight with the motors is about thirty tons.

The trucks are from the shops of the McGuire Mfg. Co., of Chicago, and have been especially designed for this work. In these trucks the draft of the train is taken directly on the journal boxes, instead of through a swinging bolster, the entire top frame having sufficient lateral motion to cushion on curves. The top frame is held in central position in relation to the wheels by a novel double-rocker connection between the truck and the elliptical springs, part of the strength of these being utilized to cushion the side motion of the truck on curves and return it to its normal position on the straight track. The weight of each truck is 1000 pounds, wheel base five feet six inches, or six inches less than any other truck made for this purpose to accommodate two motors of the capacity of those used in this equipment. This is obtained by omitting the swinging bolster and substituting a better equivalent.

The general character of the electrical equipment is similar to that in use on the Metropolitan West Side and Lake street elevated electric railroads in Chicago and on the electrically operated divisions of the N. Y., N. H. & H. R. R. The equipment of each motor car consists of four G. E. 50 motors and two K 14 series parallel controllers—motors and controllers also both especially designed to meet the peculiar requirements of bridge traffic. The motors have the usual characteristics of all General Electric railway motors. They are fully protected against the entrance of either dust or water and for their power are extremely light, weighing each about 3,500 pounds. The armatures are of the slotted core type, each winding lying in its own slot. The method of winding adopted allows of the removal and replacement of any of the armature coils with little or no disturbance of the others, while the crossing of two wires of large difference of potential is avoided. The motors are spring-suspended, and the two forward ones are provided with a small roller in the front upon which the cable can run, and thus prevent injury to cable and motor. The illustration shows one truck of a motor car with a controller and gives a fair idea of the compactness of the equipment. Each motor car has each truck similarly equipped.

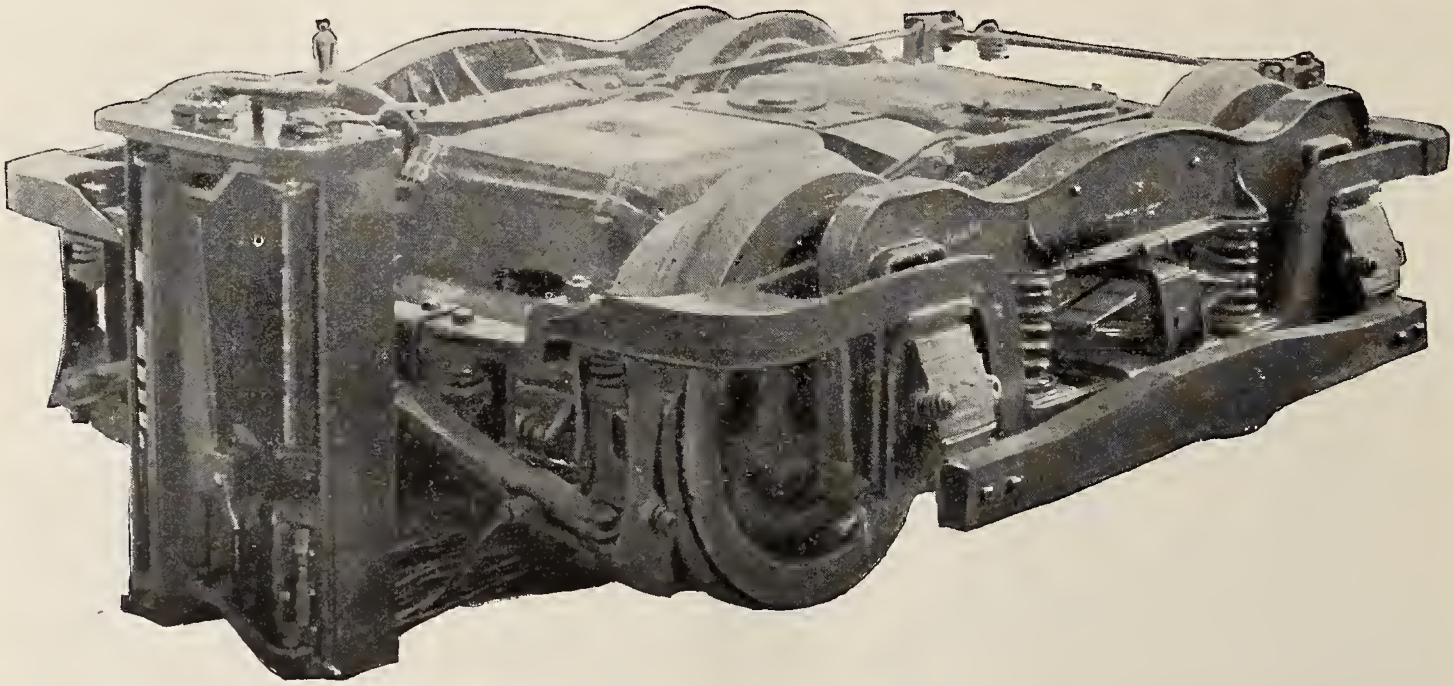
The series parallel controllers embody the magnetic blow-out principle, and in their operation, when the current is shut off, resistance is first introduced and the potential at the motor reduced before the circuit is broken. This avoids any strain on the motors due to sudden rupture of the current. When the circuit is broken the arc is immediately blown out and the contacts do not suffer, the blow-out serving to chill the arc by spreading it over the surface of the breaking points instead of confining the root of the arc to its point of origin and consuming it.

The total number of notches is thirteen, six of the resistance points being in series and five in parallel. The reversing switch is, of course, arranged for four motors. The handle is interlocking and cannot be moved unless the controller handle points to the off position. The

controller stands 46¾ inches high, 22¾ inches wide, and 10 inches broad, and is secured to the ironwork and floor of the platform.

The resistances suspended beneath the cars are twelve in number. They are of the packed ribbon type, set in open iron boxes.

Beneath each platform is an automatic circuit breaker, which effectually prevents any injury to the motors from a sudden rush of current. The breaker is set at 800 amperes, and should the current exceed this a latch is tripped by the action of a solenoid, and the contacts in the device are instantly separated, breaking the circuit. Additional protection is provided by cut-outs also embodying the magnetic blow-out principle, whereby the arc formed at the disruption of the fuse is magnetically extinguished.



New Electric Trucks Used on the Brooklyn Bridge.

The circuit breakers take the place of the well-known main circuit hood switches, and are wired in multiple instead of in series. In the experimental car, to guard against any possibility of one being closed while the motorman was at the other end of the car and desired to open the main circuit, only one handle was provided. This handle could not be removed from the circuit breaker without breaking the main contacts, and when removed the circuit was locked open. In the new equipment no danger would ensue if both were thrown in, as the effect is simply to make the trolley connection alive on the controller, but, the controller being open, no current flows. In this respect the new equipment is superior to that used on the experimental car.

The current is taken from a third rail in a manner similar to that used on the electric roads in Chicago. This third rail runs on the outside of the service track, and parallel with it across the bridge, and at all crossings and switches about one foot from the outside rail. The third rail used is the ordinary T rail bonded with No. 0000 bonds. They are laid on insulators, one of which is set every fifth tie. These insulators are square, pyramidical pieces of vitrified clay with a single petticoat, and are supported on iron pins fastened to the tie. The top of the pyramid carries two jaws, which grip the foot of the third rail and are screwed up by means of a bolt and nut. For the return the service rails are also bonded with No. 0000 bonds. Between the journal boxes of each truck and on each side of it is an oaken beam, from the centre of which depends one of the contact shoes. These shoes are slung loosely from jointed and slotted hangers and, having an easy up and down motion as well as the ability to take any angle within a wide range, follow the surface of the rail at all times and make perfect contact. The shoes are of cast iron about twelve inches long by ten inches wide, and one-half inch thick. Each weighs about ten pounds, and is wide enough to slide over all breaks on the third rail at all switches and crossings, and one shoe is always in contact. An insulated flexible cable connects the shoe to the motor.

The electrically equipped cars are known as the motor cars, and one is allotted to each train, forming part of it and carrying its share of the passengers. Its function is similar to that performed by the switching locomotives. The train empties at the terminal, the motor car draws or pushes it from the incoming platform to the tail track and thence to the outgoing platform. It then moves the train over the tilting sheaves so that grips on the other three cars may seize the cable, when the current is shut off and the cable performs its ordinary functions. Under the conditions of the contract, the power of the four motors must be sufficient to propel the fully loaded train weighing 120 tons across the bridge at the speed of the cable, 11.3 miles an hour, in case of break-down of the cable. With the motors, the heaviest bridge trains are readily hauled up the 3.78 grade, and so far as they are concerned comply fully with the conditions. During the early morning hours the motor cars will handle the entire traffic of the bridge, after the cable has stopped running.

The motors will also help heavily loaded trains up the grades and keep the grips from clipping the cable. The substitution of the motor car eliminates one set of grips, while adding about twelve tons to the weight, and three grips are not always sufficient to handle trains which may be heavily loaded. As soon as the second set of tracks is ready, and the additional cable running, it is expected that the headway will be reduced from ninety to forty-five seconds.

The power to run the trains is taken from the Kent Avenue station of the Brooklyn City Railway, the return wire being connected to the rails of the surface road.

The efficiency of the electric system under emergency was tested on the evening of December 2, 1896, when the operation was accidentally suspended. The rush homeward from New York to Brooklyn had already set in and the entire operation of the bridge for some half hour was thrown upon the motor cars. According to the bridge authorities the traffic was carried on without any appreciable loss in headway.

Jacksonville, Fla.—The Union Trust Company, who purchased the plant of the Jacksonville Electric Light Company, will take steps immediately toward rebuilding the plant. The company will overhaul the entire line, put in larger engines and dynamos, and, in fact, put in a new equipment. It is expected that the work will begin very shortly.

CHLORIDE ACCUMULATORS.

The advantages of the storage battery for purposes of regulation has become clearly evident to even the lay mind. In plants required to supply power in excess of their maximum capacity the storage cell is of uuutterable benefit. Instead of buying more machinery, storage batteries are installed, which, being charged during the interval of lighter load, become the recipients of power that may be used to the greatest advantage when the "high load peak" makes the period of greatest demand.

The use of storage batteries, like that of other kinds of machinery, is purely a question of finance—a decision best reached by a review of the circumstances that seem to invite their installation and a calculation in dollars and cents of the advantages gained.

Central stations in Germany have accepted them as the proper adjunct to their work. This country has followed, and the call upon the Electric Storage Battery Co., of Philadelphia, has become heavy at this present time.

The illustrations show the nature of the installation made for the Union Traction Co., of Philadelphia, a company operating 500 miles of road.

The plant was the result of a "toss up" between a new power house or a battery sub-station, the object in view being its use at the end of an eleven-mile feeder, one of the most important of the traction company's lines.

The cost of copper that is saved by substituting a storage battery plant for lines is enormous. At least four or five times the expense of a battery outfit is incurred if copper is selected to serve the same purpose. Aside from the operating expenses of even a moderately small station, the commercial considerations rendered the further discussion of anything else useless.

Before batteries were installed at the end of the feeder, a 50 per cent. variation in pressure existed. Fig. 1 shows the regulation effected by means of the battery. The hours between 1 a. m. and 5 a. m., when the battery is out of service, are also indicated in a striking manner.

The cut in Fig. 2 gives the present scope of regulation 200 horse-power, which may be increased if necessary to 800 horse-power.

The load varies from 100 to 700 amperes. The feeder is constantly loaded up to 400 amperes, the battery charging or discharging to preserve this condition. In practice the feeder load remains constant and independent of the line changes.

Fig. 4 illustrates the battery house containing 248 cells of thirteen plates each, type G, chloride accumulator.

Four hundred horse-power for one hour is the hustling rule of maximum discharge. The plates are contained in lead-lined boxes mounted on oil insulators.

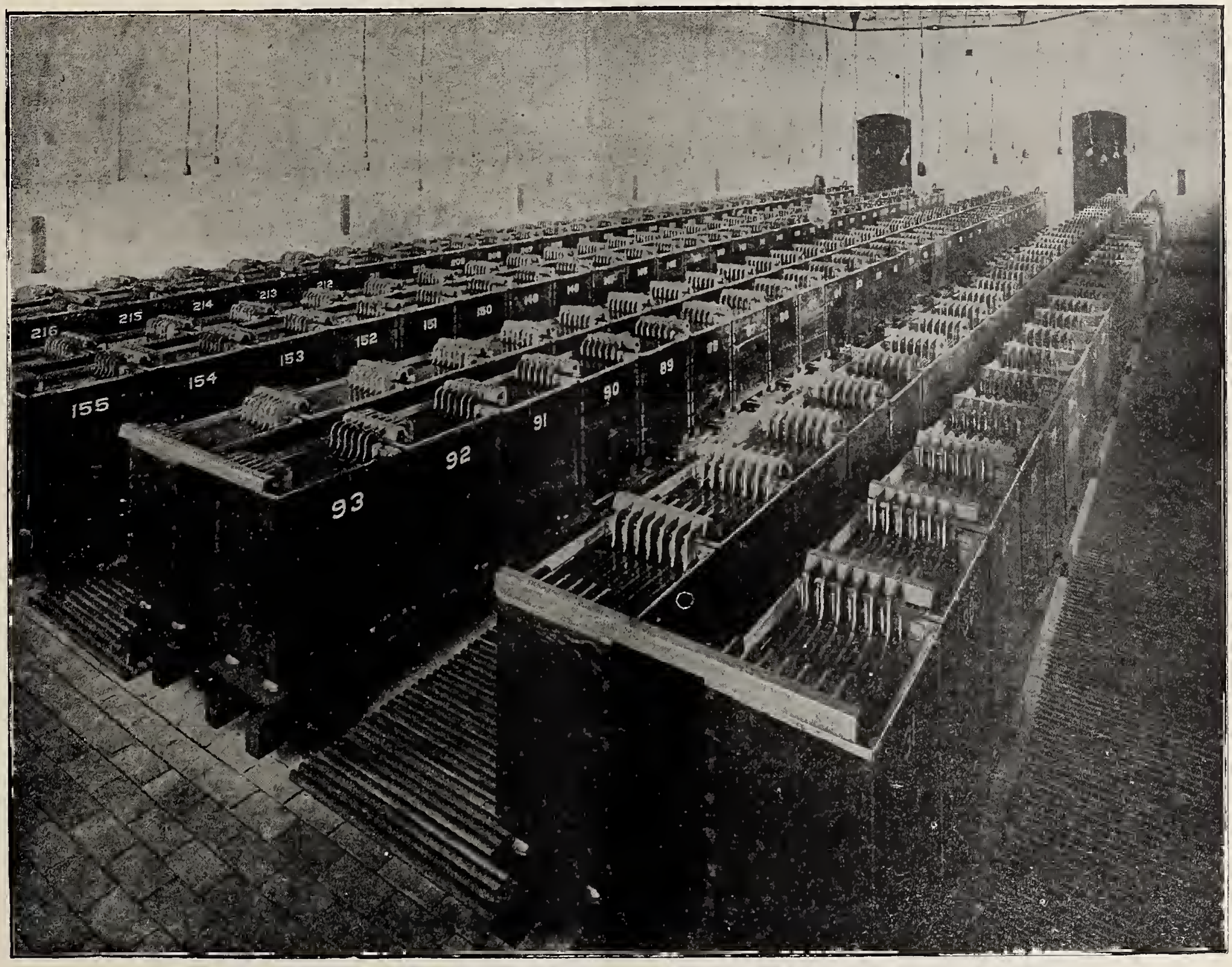


Fig. 4.

The switchboard shown in Fig. 3 contains three panels controlling the battery feeder and line. An ammeter, circuit breaker and knife-switch in each of the three circuits, and a voltmeter and wattmeters in the battery circuit, complete the equipment.

The great practical advantages of this installation are many. As we have stated, within certain limits a moderately sized plant may increase its capacity with great profit by adding a storage outfit, and thus increase its scope and, in all likelihood, its dividends beyond the extent the amount expended would seem to invite.

Cumberland, Md.—The Cumberland Ice Company are considering the advisability of adding an electric-light plant for street and house illumination to their present equipment.

Vicksburg, Miss.—Improvements will be made shortly to the plant of the Vicksburg Electric Light Company by the addition of new machinery, etc.

A THOUSAND LIGHT SIGN.

IT ADORNS THE FACADE OF THE NEW GRAND THEATRE BUILDING.

The largest electric sign in New England, that on the Washington street facade of the New Grand Theatre was lighted for the first time on Saturday night, and attracted the attention of thousands of passers-by. The sign is composed of 1000 incandescent lamps of 32-candle power each, and the letters which they make are about four feet high and about the same width. The sign tells the name of the theatre, and underneath gives the prices.

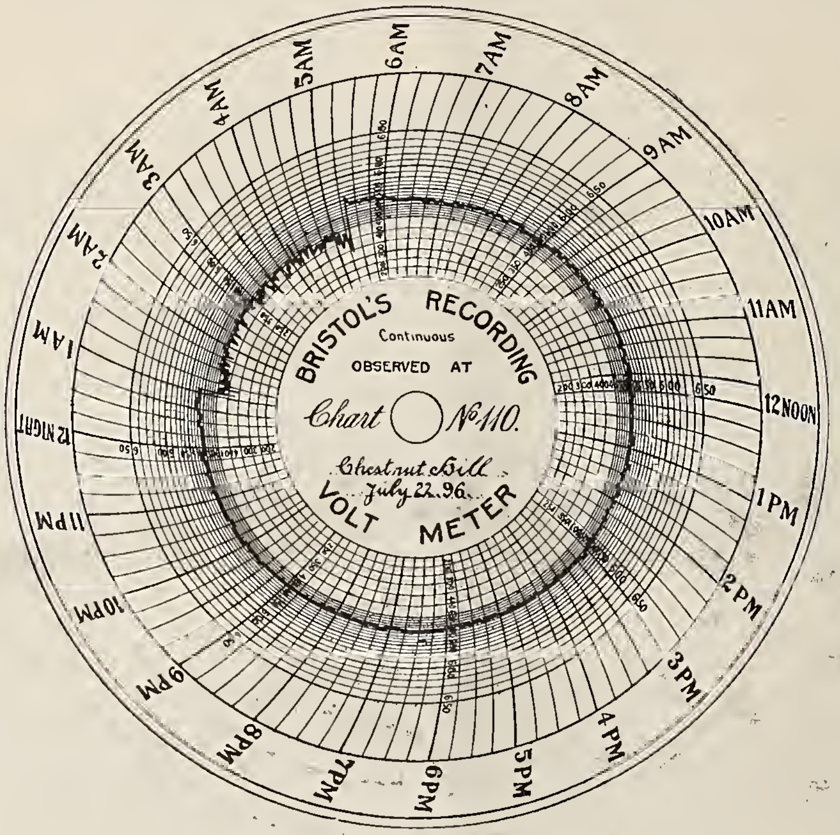


Fig. 1.

It took four men a month to make the sign, and it cost the company that erected it about $5,000. Unlike other

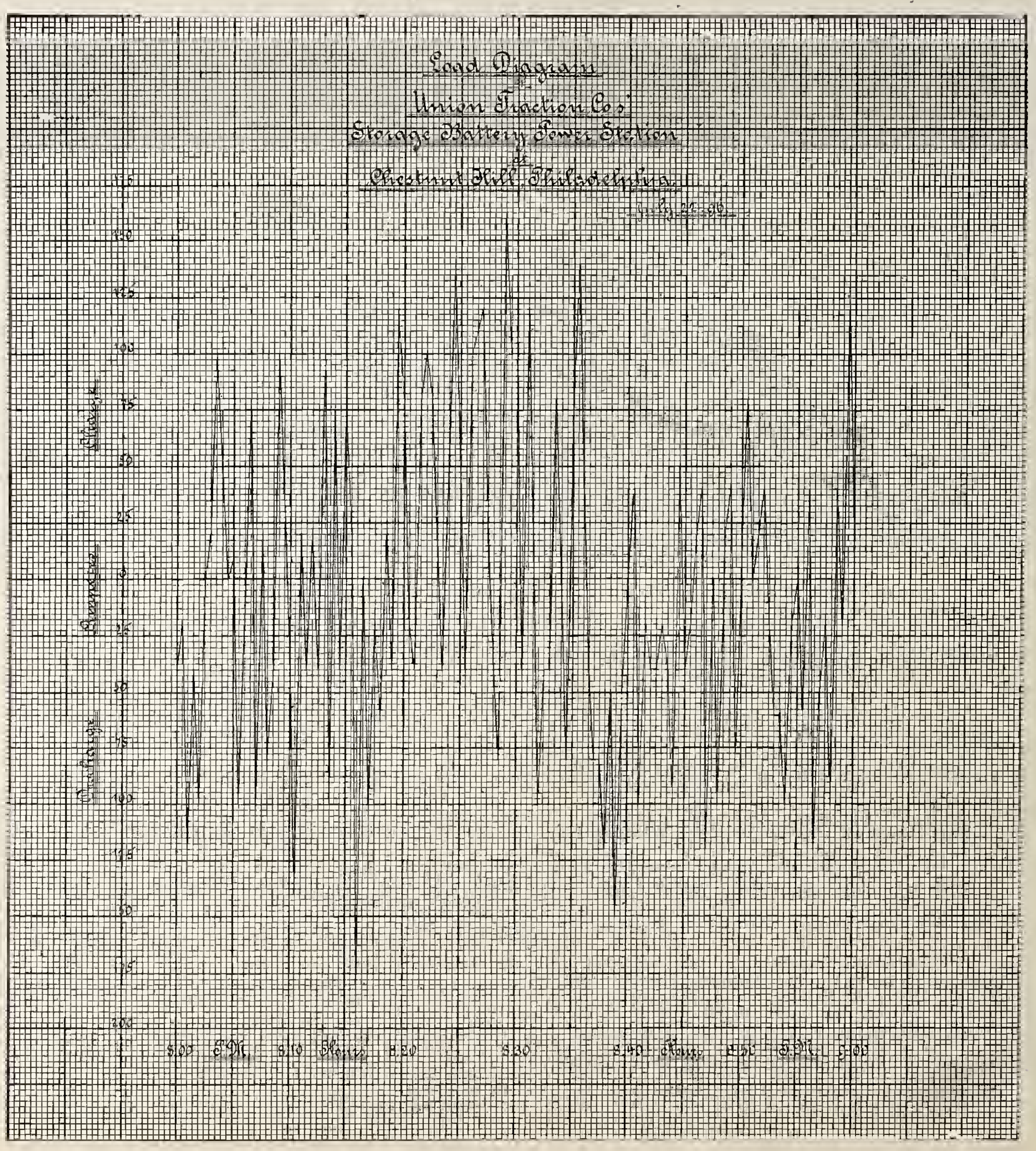


Fig. 2.

electric signs in New England, the letters in which the electric lamps are set on this one are made of block tin, instead of wood, and they are lighter and will stand wear much better than the old style signs. Three separate currents from the street main supply the lights, and the sign is controlled from three switchboards in the theatre.

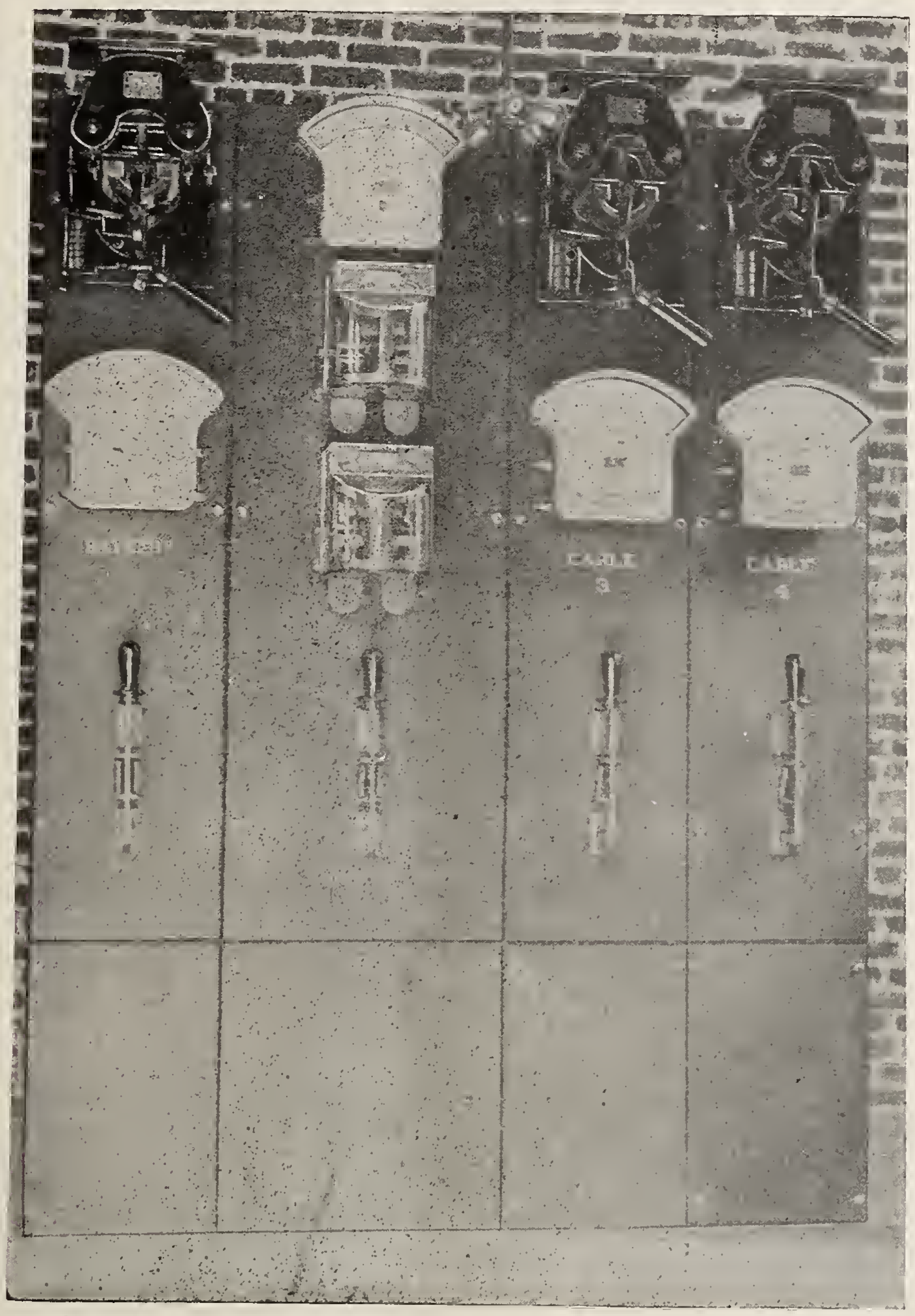


Fig. 3.

The sign, when lighted, makes Washington and Dover streets as bright as midday. It costs Proprietor Lothrop $300 a week to run the sign five hours a night, and he considers the advertising he gets from it second only to that he gets from the same amount expended in advertising in The Herald.—Boston Herald.

SOME ACCOUNT OF THE EVOLUTION OF TH INDUCTOR ALTERNATOR.

(Continued from Page 709.)

A machine designed by S. M. Martin and S. A. Varle is shown in Figures 7 and 8. It consists of two inducin magnets, with an induced magnet between them, con nected to the soft iron yoke. A revolving, toothed iror disk alternately closes the magnetic circuits of the twc inducing magnets through the induced magnet. This

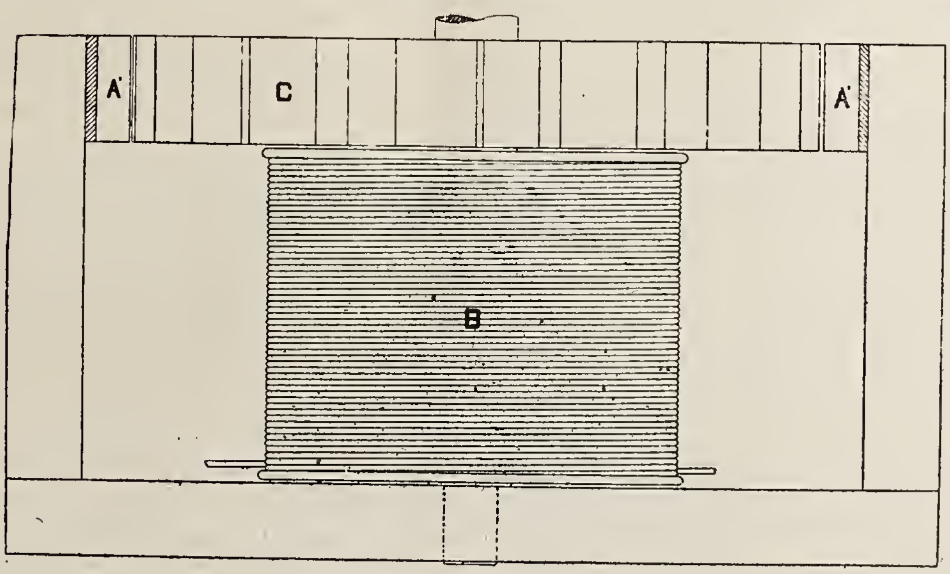


FIG. 7.

S.M MARTIN. S.A. VARLEY. 1868.
A'A' INDUCTOR POLES.
B INDUCED COIL.
CC KEEPERS.

(Continued on Page 732.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—SPEECH OVER THE ATLANTIC CABLE.

El Paso, Nov. 28, 1896.

To the Editor:

Dear Sir:—The difficulties in the way of ocean telephony may be so reduced by the expenditure of a little care that I think *speech over the Atlantic cable* will be possible in a few years' time.

The trouble, as I recognize it, seems to be the extreme slowness of transmission of pulsations or signals due to the receptive capacity of the cable for electricity, thus necessitating a very strong current if the other end is to be quickly reached. Not being a technical student, but merely an outsider grounded on a few elementary principle, would it be too much to ask your kind assistance in explaining the limitations and future possibility of ocean telephony? Indeed, if not too much, whether the neutralization of the receptivity of the cable would not greatly improve it? Yours truly,

James R. Rondin.

(A.)—The removal of capacity from the Atlantic cable would mean the instantaneous transmission of messages from point to point. A wire suspended in air has a little capacity, but not enough to seriously affect the rapidity of passing signals. Were the wire buried in earth, this influence would be directly felt over long lines. When immersed in a vast body of water, the wire being thousands of miles long, the capacity of the cable becomes very great. It requires a large charge before it becomes able to give issue to a signal at the other end; the cable practically overflowing when operating a telegraphic device; and conversely, demanding a reverse charge to sweep away the first before the cable is clear for a return signal.

The superior insulation of the cable is thus a test in its way for the capacity of the cable. A material that has insulating properties, yet refuses to allow static induction to occur through it, would entirely destroy this phenomenon. Otherwise the cable construction must be such that the current sent in neutralizes the capacity and allows a free and ready exit of the current. Until then the feeble currents of telephony are useless in the cable, being lost as completely as a single drop in the entire ocean.

(Q.)—SMALL HOME ELECTRIC LIGHT OUTFIT.

Eaton, Dec. 3, 1896.

Editor of Inquiry Column:

Dear Sir:—We have our home in the country; practically on the outskirts of the city of Eaton. A small electric outfit for road lights and indoor lights in summer would be very agreeable. I thought over the various ways of procuring a current and listed them into this form:

Water-power and dynamo,
Wind-power and dynamo,
Kerosene engine and dynamo,
Gasoline engine and dynamo,
Batteries,

and, upon examining them, find water-power out of the question; batteries, too much trouble; but wind, kerosene and gasoline worth choosing from. I think wind a cheap power, but unreliable, so I struck that out also. What I want to know is, which of the remaining two is the best —gasoline or kerosene engines, and whether the engine will demand attention, and therefore force me to use storage batteries. I would then shut the engine off at night and use the lights. Do you think I have reasoned properly in this matter? Yours respectfully,

(A.)—The choice of gasoline or kerosene engines we will leave with you. Both are very good for such work, and by going to good firms you will not be dissatisfied with what you get. Storage batteries would be necessary for the purpose you have in view, but the results accomplished will bring untold satisfaction if the details are carefully carried out.

(Q.)——— Pittsburgh, Dec. 4, 1896.

To the Editor:

Dear Sir:—As a reader of your journal can you let me know whether a copper and iron wire act the same for a telephone line? Yours respectfully,

John R. Braddock.

(A.)—A short line may be made of either metal, preferably iron, because it is the cheaper; but if the line is to be long, covering many miles, copper is superior to iron. Long distance telephone lines are made of copper.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the 111th meeting of the American Institute of Electrical Engineers, to be held at 12 West 31st street, New York, Wednesday evening, December 16, a topical discussion will be held, devoted to a consideration of the relation of the Roentgen ray to physics. The discussion will be opened by Prof. Rowland and Prof. Elihu Thomson. Dr. M. I. Pupin, Dr. A. E. Kennelly, Mr. Max Osterberg and others have signified their intention to participate.

THE ACHIEVEMENTS OF PHYSICAL CHEMISTRY.

"Physical chemistry is the chemistry of the future." These words, quoted from an address by Prof. Du Bois-Reymond, were used by Ostwald ten years ago in the introduction to the first number of the "Zeitschrift fur Physikalische Chemie." In using these words, Du Bois-Reymond looked forward to a time when it shall be possible to give a mathematical expression to all forms of chemical knowledge. The picture in his mind seems to have been that of a sort of astronomy of the atoms, in which the motions and forces within the molecules shall be known very much as are the motions and forces within the planetary system.—London Electrical Review.

NEW YORK ELECTRICAL SOCIETY.

The next (178th) meeting of the society will be held at Columbia College, on Thursday, December 10, at 8 P. M. The evening will be devoted to a demonstration of "How to Test the Commercial Efficiency of Dynamos and Motors," an entirely novel form of experimental lecture.

A 3-H. P. dynamo and a 3-H. P. motor will be set up and tested, in full view of the audience, by a special corps of experts.

Professor F. B. Crocker will describe what is being done, and will make the actual tests; Ex-President C. O. Mailloux will take the readings, and President C. E. Emery will record them on the blackboard.

The audience will be informed of the reasons why each step is taken; will be able to see how the method of testing is conducted from stage to stage; will see the results placed on the diagram as soon as reached, and will thus enjoy a practical lesson in one of the most important branches of electrical engineering.

Yours truly,

George H. Guy, *Sec.*

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CONTENTS.

EDITORIALS
- Modern Magic 731
- The Storage of Power 731

GENERAL SUBJECTS
- Greater New York Joined by Electric Cars 725
- Some Account of the Evolution of the Inductor Alternator 729
- Electric Heating and its Calculation 736

MISCELLANEOUS
- A Thousand Light Sign 728
- American Institute of Electrical Engineers 730
- The Achievements of Physical Chemistry 730
- New York Electrical Society 730
- Third Annual Ball 734

INQUIRY COLUMN 730

TRADE ARTICLES
- Chloride Accumulators 727
- Up-to-date Generators 735
- Report of the Franklin Institute 737

ELECTRIC STOCK QUOTATIONS 740

MODERN MAGIC.

We are all modern magicians. The qualifications we possess that are seemingly thrust upon us, and which we add to our native stock of potential powers, give us that title. Skill is a product of practice. Magic is a result of skill. Not the wild, fantastic and illimitable vagaries that our ancestors bowed to, but the magic of mechanism, a healthier and yet not less prosaic means of arousing an insuppressible wonder.

What is considered within the field of magic if it is not that which seems beyond explanation? And in these times is that ever admitted? The lines of modern magic are not arbitrary. They are part and parcel of itself, as much as tissue and vitality bear that relationship to ourselves. Aladdin rubbed his magic lamp and a mighty genie appeared. The genie we summon today is mightier and better, because real. And thus a brief review of childhood's tales with their mystification and absorbing interest will be replaced by modern myths, or perhaps, to use a better expression, by modern miracles. The apparently inexpressible relationship between cause and effect are but a corollary to the effect. Science spins its web of explanation with its circling centres of truth; it attaches itself to an old wall that time has all but beaten down and remains until the wind of adverse opinion sweeps it away. An opinion becomes valuable by its negative attitude. It may benefit the clamors of argument, instruct the patient inventor, and throw open the portals that lead to the new world of modern magic.

To made use of natural principles is the object of the newer and most modern minds. The great laws that produce all phenomena are the only adjuncts that congest the inquiring mind into a focus of weariness. Behind all the magic of application or of the most impressive construction lie these great basic laws, each unchangeable and each ever-wonderful in their unknowable cause and unalterable constituency.

THE STORAGE OF POWER.

Power is always stored. It is this difficulty that makes the employment of a suitable device a necessity; one in which it may be on tap when required. The pound of coal, gallon of oil or load of wood exemplify this fact, but the steam boiler, lamp and stove force us to believe that its usefulness is an element dependent upon its means of use.

This is the time when energy is stored under every possible circumstance. No man is richer than he at whose command lie stores of energy. Perhaps in the future, when fuel fades away, the possessor of power will be the owner of power—of coal mines, water power, or machines that may take crude material and supply it. In the field of electrical applications the storage battery has been adding lustre to its name, The time is not far off when the most necessary auxiliary to a power station will be the accumulator. When lectures on the financial management of stations are properly given, and the money wasted daily is shown in heaping hillocks, copper and machinery will not be added to relieve the pressure of service, but a cheaper and equally good substitute—the storage battery.

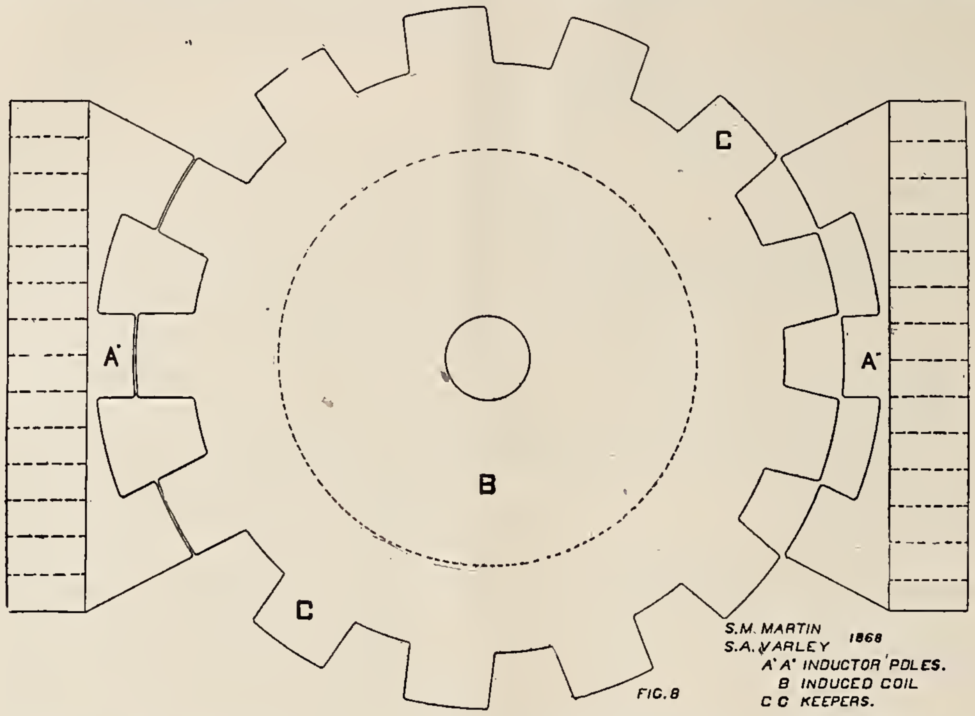
A contemporary of ours contains the following useful information as given by Dr. Francis B. Bishop, an electrical expert:

"Every effort should be made to liberate him at once. How is this to be done? First, keep cool; don't lose your head. Do not place yourself in circuit in trying to help others out. When the victim is a lineman and up among the wires or on a pole, nothing much can be done until the current is shut off at the power house. Should the victim be lying upon the ground, grasping the wire in one or both hands, take a dry stick and push the person from the wire, or wrap a large, dry silk handkerchief around your hand and catch hold of the victim's coat tail or dress and pull him or her from the wire. As an extra precaution, if your own coat is perfectly dry, you might place it upon the earth to stand on. Under no consideration catch hold of or tamper with in any way the wire, unless you are positively certain that you are thoroughly insulated by rubber boots or gloves, or both. Even then it is better to pull the victim from the wire. Remember always that the current follows the course of least resistance, and is not going to go out of its path for the sake of running into you; nor will it vary its course if you get in its way, unless your body puts in more resistance than that of another circuit.

Therefore, never under any circumstances, when you are removing a person from a live wire, allow his body to leave the earth. Or, in other words, don't lift him. Keep him to the earth, for when his body leaves the earth your body becomes the conductor, and you simply add another victim to the list. An iron rod or heavy copper wire run deeply in the ground, in such a way that when the free end is liberated it will spring to the live wire above the victim, will take the current from him so that he can be pulled away. Even then be cautious. When the victim has been released from the wire proceed at once to artificial respiration. Be sure that the clothing is well loosened, especially about the neck and waist.

Notwithstanding Dr. Beleile's valuable experiments upon dogs we can never tell how much current a person has received, or exactly how much resistance he offers to the current. Besides, the number of cases actually resuscitated encourages vigorous and prolonged effort. Personally, I should favor suspending the patient, head down for a minute or two at a time, keeping up artificial respiration all the time, having the tongue well pulled out. Alternate the suspension with lying upon the back.

(Continued from Page 729.),
machine may be considered to be Henley's, with one limb of the electro-magnet suppressed and only one limb of the inducing magnet in action at a time.



S.M. MARTIN 1868
S.A. VARLEY
A' A' INDUCTOR POLES.
B INDUCED COIL
C C KEEPERS.
FIG. 8

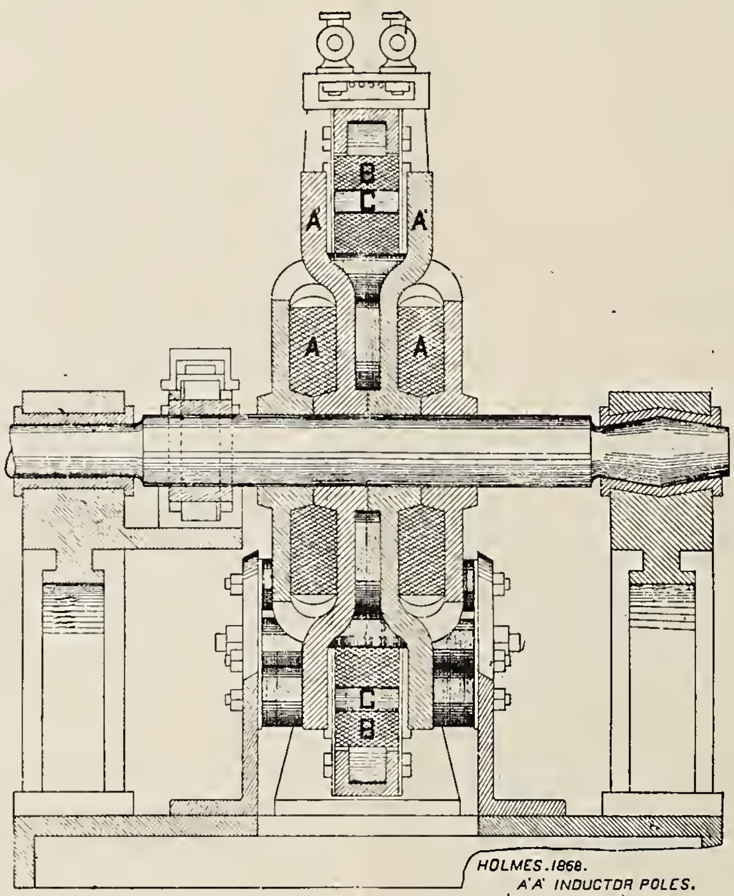


FIG. 9
HOLMES. 1868.
A'A' INDUCTOR POLES.
AA EXCITING COILS.
BB INDUCED COILS.
CC KEEPERS.

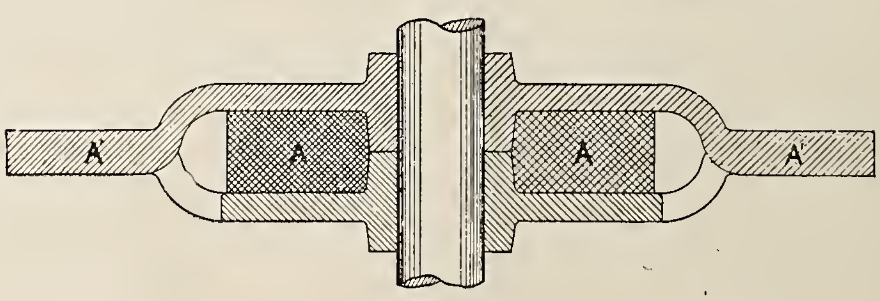


FIG. 10

HOLMES. 1868
A.A.' INDUCTOR POLES.
A.A. EXCITING COIL.

The machine described by Holmes, Figures 9, 10 and 11, in his English patent of 1868, is worthy of considerable attention. In some respects it may be considered as an inversion of Wheatstone's first design. A single exciting coil gives rise to a number of poles, while the induced electro-magnets are separate and distinct. An interesting feature is that the cores of the induced magnets are slotted to prevent Foucault currents. The exciting coil

feature has been adopted in all modern inductors with which I am acquainted save one, and the subdivision of

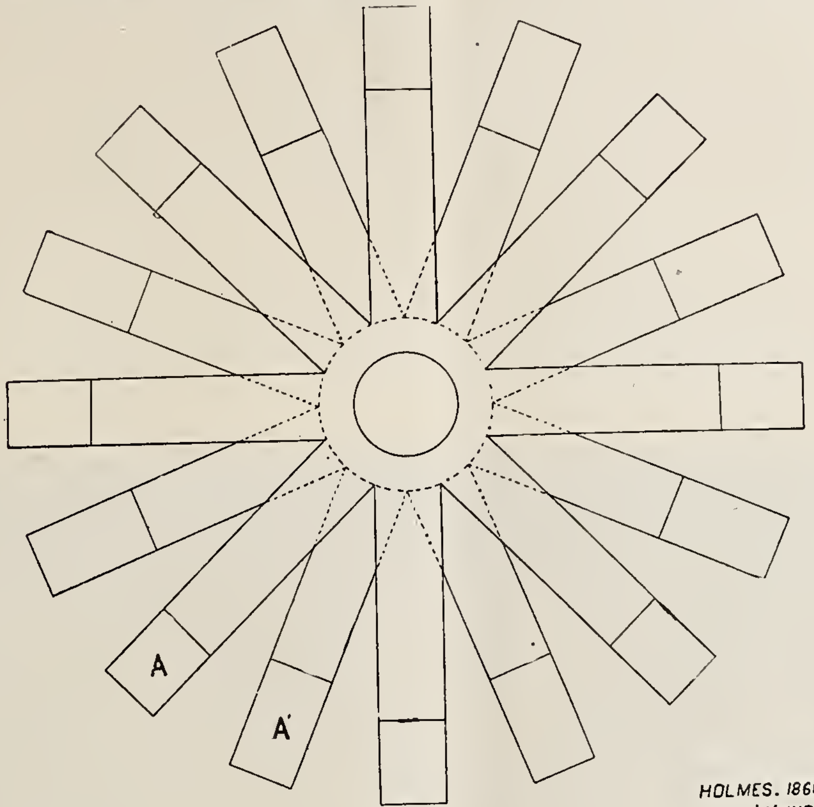


FIG. 11

HOLMES. 1868.
A.A'. INDUCTOR POLES.

the iron in armatures to prevent Foucault currents has become a matter of course. Yet, in respect to the steadi-

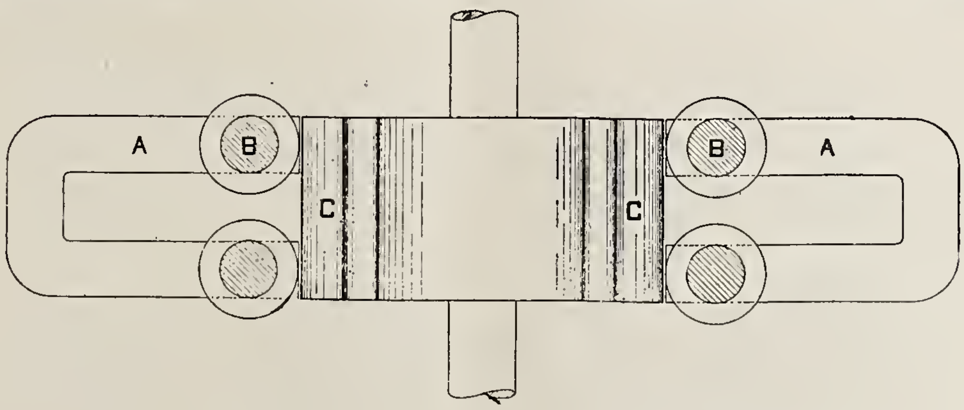


FIG. 12

C.F. VARLEY. 1877.
A.A. INDUCING MAGNETS
B.B. INDUCED COILS.
C.C. KEEPERS.

ness of the flux, this machine is distinctly retrogressive and decidedly inferior to Wheatstone's second design. Holmes intended the machine for electric lighting but I

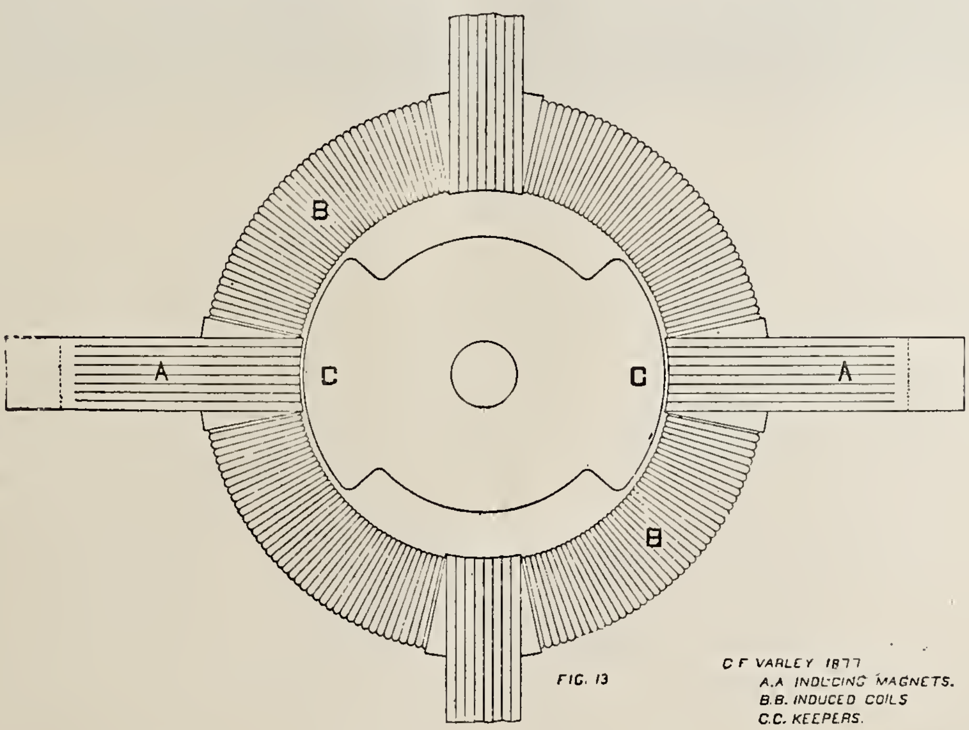


FIG. 13

C.F. VARLEY 1877
A.A. INDUCING MAGNETS.
B.B. INDUCED COILS
C.C. KEEPERS.

am not aware of its ever having come into practical use.

Gramme's invention came near putting an end to work on inductors, as, indeed, to work on alternators of any kind. Yet, in the time intervening between the introduction of the Gramme machine and the resurgescence of the alternator, provoked by the introduction of the modern transformer, C. F. Varley* designed an inductor, Figures 12 and 13, which deserves mention for its novelty. The induced coils are subject to the influence of two inducing magnets which tend to develop opposite fluxes through them. These magnets are alternately

* The figures of C. F. Varley's machine were made entirely from description. They may be quite different from those in his patent.

short-circuited by the keepers, and, in consequence, the flux through the induced coils is alternated by arranging the keepers so that they begin to short-circuit one inducing magnet before entirely open-circuiting the other; the flux in the inducing magnets is kept more or less constant. In this same year Paul Jablochkoff took out an English patent for an inductor alternator. It is of the single induced-coil type; but were it not for the inventor's great fame, considering the date, it would not be worth attention.

Even the best of these early inductors must have had vast iron losses. In most cases there was no thought of preventing them, and, when preventive measures were adopted, they were entirely inadequate. The mass of iron subject to magnetic change was always, relative to the size of the machine, enormous, thus necessarily increasing the hysteresis loss; while no sufficient provision appears to have been made for the prevention of Foucault currents. The machine of Klimenko, exhibited at Vienna, which required more power to drive it when running light than when loaded, was not, I think, exceptional.

(To be continued.)

THIRD ANNUAL BALL

Of the Associated Employees of Zimdars & Hunt, at Lyric Hall, Sixth avenue, between Forty-first and Forty-second streets, on Tuesday evening, December 1, 1896. Music by Prof. R. E. Sause.

Officers—George T. Butler, President; Samuel Titterington, Vice-President; Louis H. Nelson, Recording Secretary; Louis Ruckle, Financial Secretary; George J. Murphy, Treasurer; Charles Miller, Sergeant-at-Arms.

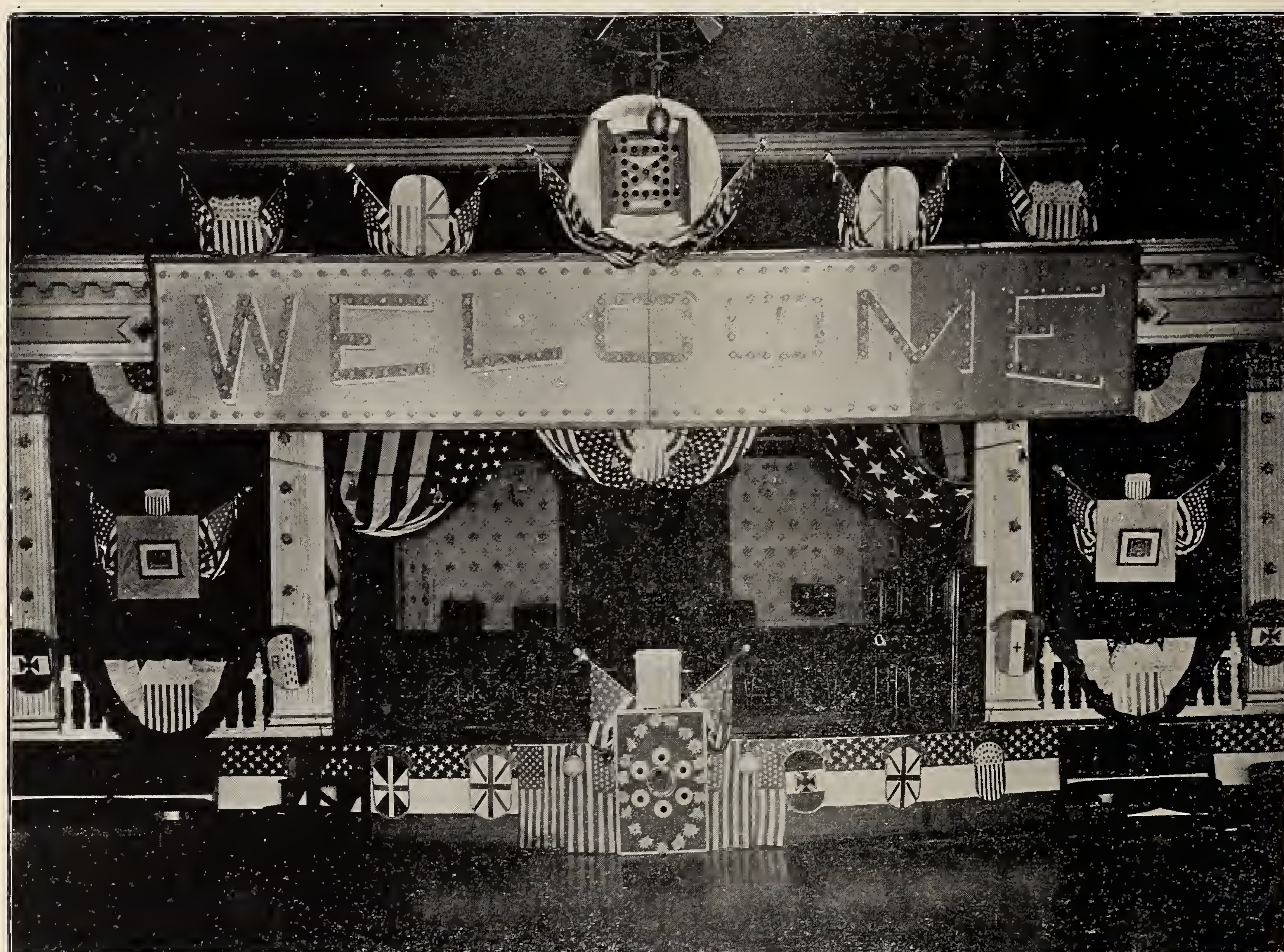
Floor Manager—George J. Murphy.

Assistant Floor Manager—Louis Ruckle.

Floor Committee—James Galvin, Chairman; O. Rudolph, C. H. Dame, P. J. Martin, William Demke, J. F. Veilberth, E. K. F. Wendler.

Reception Committee—Samuel Titterington, Chairman; Charles L. Stephan, W. Siebert, R. Wilson, C. Franklin, C. Ratchke, T. Braun, J. F. Sutcliff, R. E. Butler.

The third annual ball of the Associated Employees of Messrs. Zimdars & Hunt, the electrical engineers and contractors, of 127 Fifth avenue, New York, took place on the evening of December 1. According to the experience of the representative of The Electrical Age it



Electrical Decorations, Ball of Employees of Zimdars & Hunt.

was one of the most successful balls ever attended by him. The grand march began at 11 o'clock with 160 gentlemen and ladies. The leader of the march, after having completed a circuit of the ballroom, faced the stage and gave a signal, upon which the beautiful electrical effects in the hall burst upon the view of the audience. There was great expression of pleasure and enthusiastic applause as the audience studied the shield containing the words "Associated Employees" and the large monogram between the two words, Z and H, all worked out in colored 16-c.p. incandescent lamps on a background of pretty colors and surrounded with flags, staffs, etc. On either side of this beautiful shield, which was six feet high, were several smaller ones. All the shields were set on top of an immense design forty feet long by six feet high, and containing the word "Welcome" on a richly colored background and border, the letters being formed of colored incandescent lamps. These designs formed an arch over the stage. On the sides of the arch were neat designs formed of

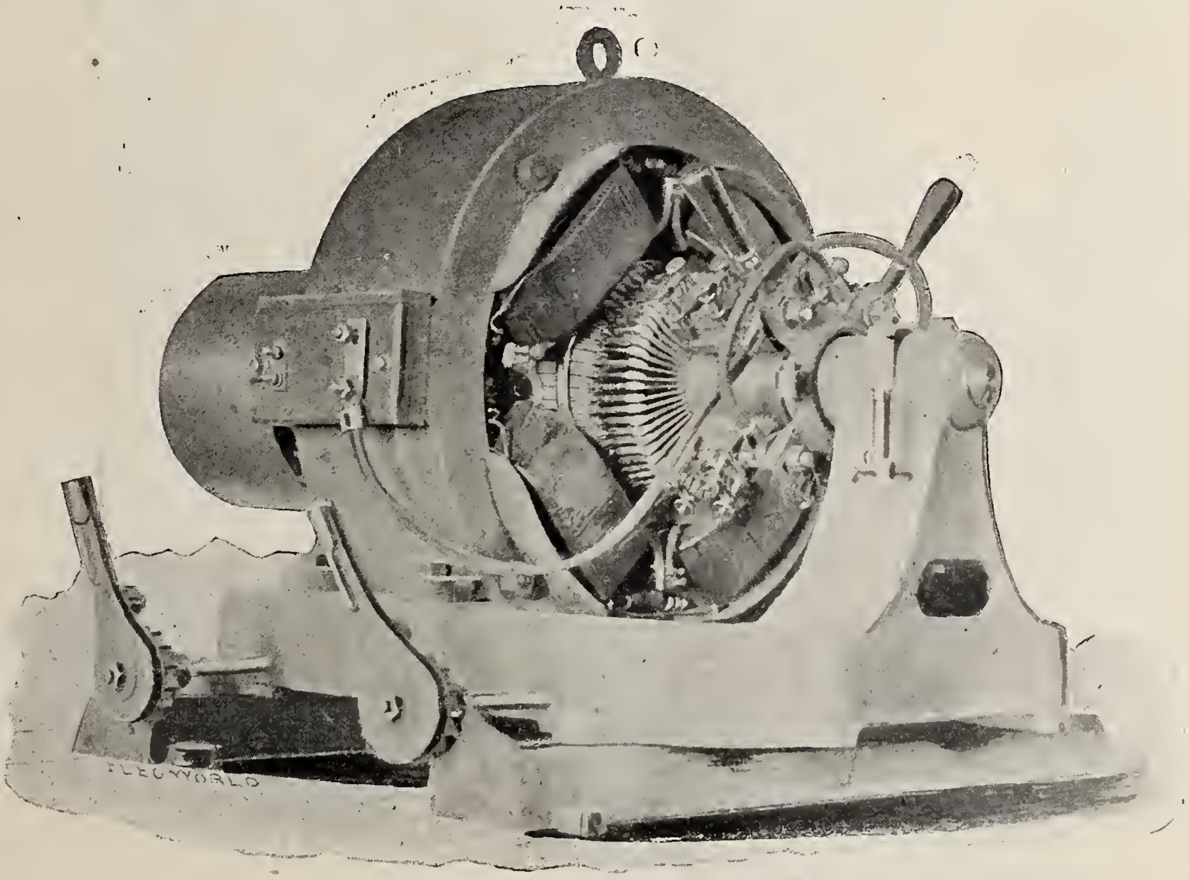
the national colors and incandescent lamps. On the front of the stage was a large shield, six feet high, containing white and colored lamps, in the centre of the shield being a 16-c.p. ruby incandescent lamp with a parabolic reflector, the two in combination forming an immense red rose. "Miss Liberty," over the mirrors opposite the balcony, held a 32-c.p. lamp in her uplifted hand. Four hundred 16-c.p. incandescent lamps were used in the decorations, together with 600 feet of white-core "Habirshaw" wire. In the word "Welcome" alone were 225 lamps, the remainder being used in the shields and other decorations, all of which were designed by F. P. Smith. All the work in connection with this was done during the evenings of the previous week by the employees of Messrs. Zimdars & Hunt.

Mr. John T. Hunt, of the firm, was escorted to the middle of the ballroom before the grand march was started, to witness the electrical effects. The past two balls having been conducted excellently, their fame had spread so that the attendance at this one surpassed that of the previous ones by at least 25 per cent.

Among the guests of the evening were E. S. Keefer and wife and P. T. Ackerson, of the Western Electric Co.; Messrs. Godfrey, Harrington and Olsen, of the Habirshaw Wire Co.; Mr. Connell, superintendent of the Produce Exchange building; E. L. Morley, of Hatzel & Buehler; Messrs. Stevens and Gutzell, of 524 Broadway; W. McMannus, superintending engineer of the Board of Education; M. Hayden, of Hayden & Co., Duane street; M. Dale, of the Dale Manufacturing Co., otherwise known as "Musical" Dale during the rest of the evening; Mr. and Mrs. D. Sheridan; E. Blanchard, of Blanchard Electric Co., Brooklyn, N. Y., and many other representative men in the electrical trade. After the first half of the programme everybody adjourned to the banquet hall, where a bountiful repast was served. After coffee Mr. George T. Butler, the president of the association, spoke of the geniality of the guests and how the employees appreciated their attendance. "Musical" Dale kept the company in a roar of laughter a good part of the time, and Mr. Blanchard also made a few cheerful remarks. Mr. J. Olsen then called upon Mr. John T. Hunt for a speech. Mr. Hunt responded by speaking of the great future of co-operation among employers and employees and recalled the excellent idea of Mr. Whitehead, who is now carrying on a successful electrical business on the West side. Mr. Whitehead was an employee of the firm several years ago and had come to affiliate. Mr. Hunt said he looked forward to the day when the employers of electrical workers, together with their employees, would form one grand order of associated employers and employees. Mr. Butler sang a song, greatly pleasing the audience. Mr. Titterington, the chairman of the reception committee, was in great demand and made all feel at home. Before the company adjourned to the ballroom Mr. J. W. Godfrey was tabled and spoke of the fitness of such a grand combination among employers and employees as suggested by Mr. Hunt. The company adjourned to their respective homes in the early hours of the morning, pleased with the evening's enjoyment and expressing universal desire to be with the "boys" at the next annual ball.

UP TO DATE GENERATORS.

The multipolar generators made by the Central Electric and Foundry Co., of No. 27 Thames street, New York, are built in capacities of from five to 250 kilowatts, of any voltage, with laminated fields. The armatures employed are of the Gramme ring type, with abundance of radiating surface and the best of insulation. The commutators are made of rolled copper and have more than the proper capacity; a decided advantage in construction.



Central Electric Co.'s Multipolar Generator.

Brush holders of new and practical design, and self-oiling bearings of sufficient surface, are points in construction worth noting. The salient poles form part of a jointless magnetic circuit. No leaks of any consequence, nor fitting is required in this respect. The careful design and elegant proportions enable this style of construction to give the greatest output and the employment of the least material. The skill and workmanship expended upon the machine make it one of the most desirable on the market. No heating, sparking or "drop" are experienced if the Central Electric and Foundry Co.'s machine is installed.

"London Invention" states that arrangements have been made by the London Electrical Cab Company to place a large number of electrical cabs, almost immediately, for hire in the streets of London.

ELECTRIC HEATING AND ITS CALCULATION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The subject of electric heating has become of commercial importance in the eyes of the world. Its study is of interest, as it lays bare the principles by which we can determine the extent and method of application of the current required for such purposes. One of the most extraordinary, yet most common, of phenomena is the heating of a wire by the passage of a current. The laws of heat were little understood at a time not much prior to the present date. Joule, of England, carefully investigated the rise and fall in temperature of bodies heated by an electric current, and thereby arrived at certain definite conclusions of the deepest interest. Before an examination is made of these facts it is best to review the physical basis of heat due to any cause whatsoever.

Heat is due to a variety of causes; amongst the most common being—

Chemical action,
Friction,
Electricity,
Shock.

It has been assumed by scientists that heat is merely a sort of motion of the particles of a body. The *faster* the particles move the hotter, we say, the body is. When chemical action occurs an exchange between different particles takes place, and this vibratory action in some mysterious manner asserts itself in the form of heat. Mechanical causes produce about the same condition, that is, a rude disturbance of the particles, and the results of friction or concussion are plainly visible—the action of a brake on a railroad train in producing sparks, and the blow of a steam hammer on a piece of iron heating and reddening it.

Electricity, in addition to its chemical and magnetic effects, produces heat. It always produces heat in its circuit, and that heat is due to something like an internal friction which the current meets with in the wire; it cannot excite heat unless the circuit has resistance, and as every electric circuit has some resistance, heat is ineradicable and is inseparably associated with the flow of a current.

Heat is work or power; that is, it can be measured in foot pounds.

One horse-power is equal to 33,000 foot pounds a minute, or is equivalent to one pound being raised 33,000 feet *in a minute*, or 33,000 pounds raised one foot in a minute. In either case, or any variation of it, the foot-pound of one horse-power must be the same.

Joule discovered that the heat required to raise one pound of water one degree, Fahrenheit, was equal to 772 foot pounds. This brings us at once to the previous statement that heat represents power, and a thorough comprehension of this fact will prepare the mind for the relation it bears to an electric current.

Indicated horse-power in engines is the power the engines are producing, not what they are giving out at the fly-wheel. The difference between these two is lost in radiation, etc., and in friction. Considerable power is lost every day in the shape of heat in all engines; enough, in fact, to supply *five* times as much power as is used.

When the water in a steam boiler is being heated each pound requires 772 foot pounds to increase its temperature one degree, Fahrenheit.

A boiler with 1000 pounds of water raised through 50°, F., requires foot pounds equal to the following:

1 pound, 1° F., = 772 foot pounds,
1,000 pounds, 1° F., = 772,000 foot pounds,
1,000 pounds, 50° F., = 38,600,000 foot pounds,

or the equivalent of more than 1,000 H. P. The saving of heat in boilers is thus made manifest as a ready means of saving power.

The transformation of heat into power, or, as we are about to consider it, of power into heat—that is, of electricity into heat—is defined in the following manner:

The power dissipated as heat in an electric circuit is equal to the product of the current by the current and by the resistance.

For purposes of calculation the statement may be put into this form—

Heat = Current × Current × Resistance.

In the previous cases we have spoken of the power (772 foot pounds) required to raise one pound of water one degree, Fahrenheit; this is called Joule's equivalent. We have also given 33,000 foot pounds as the value of a mechanical horse-power. It remains to state that the *electrical horse-power* is equal to 746 watts.

Watts are found by multiplying volts by amperes.

When dealing with electrical energy, which is only measured by electromotive force and current, foot pounds cannot be used. The only two elements of power in a circuit are the units of pressure called volts and units of current called amperes.

Watts are calculated according to the rule, watts = volts × amperes.

In a circuit having 110 volts,
and 100 amperes,
the watts = 110 × 100 = 11,000
H. P. = 11,000 ÷ 746
= 14.

The kilowatt is equal to 1,000 watts, or about 1⅓ horse-power.

Heat in a circuit may be measured in watts, because

Watts = Current × Current × Resistance,
= Amperes × Amperes × Ohms,
= C × C × R.

If a circuit carries 1,000 amperes and has a resistance of one ohm, the heat dissipated equals

1,000 × 1,000 × 1 = 1,000,000 watts,
= 1,000 kilowatts,
= 1,340 horse-power.

Therefore, unless a circuit is made of the lowest possible resistance, power will be continually lost in the form of wasted heat.

Heat is measured by means of a calorimeter, a vessel containing a thermometer, a little water and a coil of wire. When the current flows the wire heats the water and raises the temperature.

The weight of the water and the number of degrees rise in temperature enables us to calculate the calorics.

A calorie is the amount of heat required to raise one gramme of water one degree Centigrade.

It is similar to the Joule, because the Joule takes into consideration one pound of water and one degree Fahrenheit. The calorie is about four times as great as a Joule.

1 Joule = .24 Calorie.

Heat requires time; therefore, in using a heat measuring instrument, the seconds must be considered.

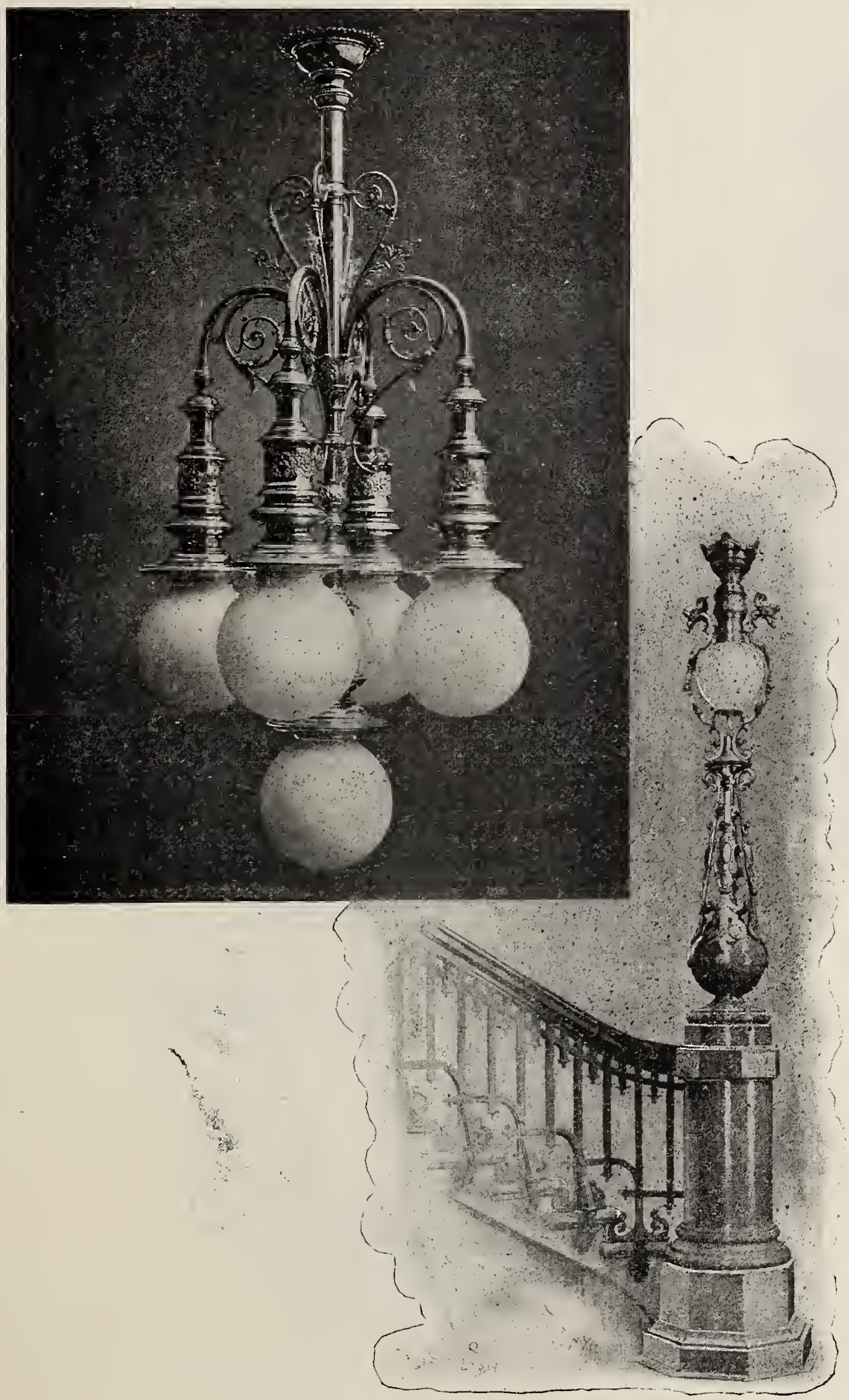
Calories are obtained by the rule—

Calories = .24 × Current × Current × Resistance,
with Amperes = 50,
Ohms = 10,
the Calories = .24 × 50 × 50 × 10,
= 6,000 per second.

Six thousand calories will heat one gramme of water 6,000 degrees, Centigrade; or, 6,000 grammes of water one degree, Centigrade; or, 3,000 grammes of water two degrees, Centigrade, etc.

If the fifty amperes flowed ten seconds, the total heat would be $10 \times 6{,}000 = 60{,}000$ calories.

Metals increase in resistance with heat. Commercial heaters are, therefore, apt to take less current after operating a while than on starting.



Newel Post and Cluster of Manhattan Lamps.

In metals the ohms resistance increase one-fifth of one per cent. with each degree, Fahrenheit. Every five degrees, F., increases the resistance one per cent.

German silver, an *alloy*, increases in resistance .02 of one per cent. for each degree, Fahrenheit.

Manufacturers of commercial heaters employ the above principles. A warm, even flow of air is desired, not an intense heat. A great surface is required to radiate the heat rapidly and at a comfortable temperature. A long spiral of iron wire wound spirally on an insulating and fireproof material is generally employed. The wire must not oxidize, and the coils must not touch. A regulating switch is required to throw the coils in series or multiple, or to at least control the current.

The heating costs in street cars from one-half to one and a half cents per ampere hour. The efficiency of electric heaters is very high, and they therefore promise to be in universal use when the cost of current, as delivered by illuminating companies, warrants it in the home.

REPORT OF THE FRANKLIN INSTITUTE

Awarding to William Jandus, Patentee of the Manhattan Lamp, the John Scott Medal.

Hall of the Franklin Institute,
Philadelphia, March 30, 1895.

The Franklin Institute, of the State of Pennsylvania, for the promotion of the Mechanic Arts, acting through its Committee on Science and the Arts, investigating the

Manhattan incandescent arc lamp, covered by letters-patent, submits the following report:

This is an arc light lamp intended to burn on a derived circuit. It consists essentially of a solenoid in series with the arc, holding in a clutch the positive carbon holder. This solenoid, being with the arc in a derived circuit, is necessarily affected as to the quantity of current passing through it by changes of resistance in the arc, and is so adjusted that when the arc reaches its full, prescribed length the attraction of the current of the solenoid weakens, and the hold upon the carbon is relaxed, feeding down the carbon, and consequently it has and needs no shunt coil. The positive carbon falls by its own weight and is maintained in a central position by a circle of rings surrounding the carbon, whose surface is tangent to the periphery of the rings. This circle of rings lies in a cone-shaped metal casing, which, on being raised, forces the rings toward the carbon and lifts it, and when it falls, loosens the grip of the rings upon the carbon and allows it to feed down. The negative carbon is fastened by a clamp in the ordinary way. To the lower carbon holder is attached a small globe, about two and a half inches in diameter and four inches high, which encloses the arc, and is inserted with both carbons into a ring at the lower part of the negative conductor, in trimming the lamp, with the upper carbon passing through the feeding ring in the solenoid above described.

The lamp is intended to burn on any ordinary direct incandescent circuit; but as the arc is found to be most satisfactory on 80 volts or less, where the lamp is used on higher voltages a rheostat is placed in series with the arc to bring the voltage within this limit.

A large spherical globe of the ordinary size is closely fitted above the arc. To the bottom of the lower carbon holder is attached a round plate, which, when the lamp is trimmed as aforesaid, closes a large opening at the bottom of the large globe, having under it a spring to allow for the expansion of air within the globe.

Fig. 1.

Fig. 2.

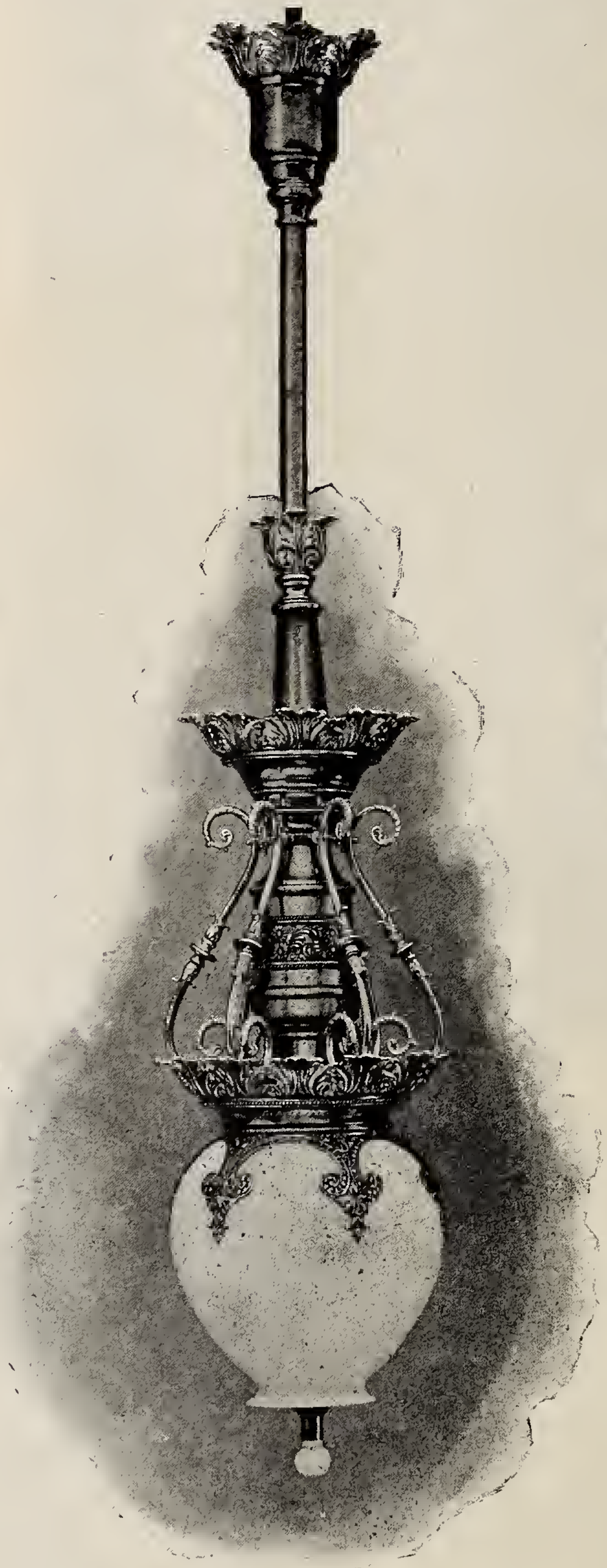


Fig. 3.

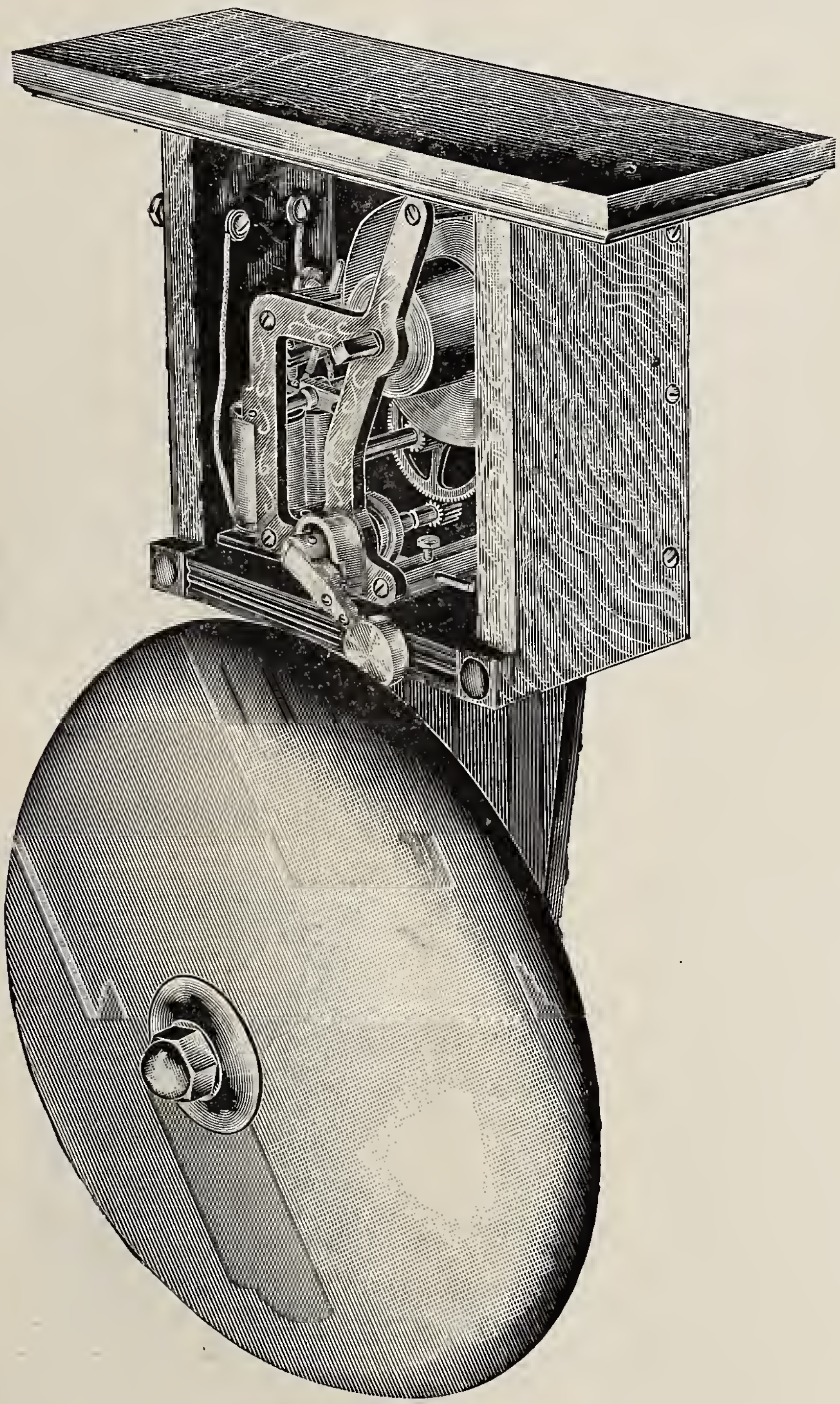
Manhattan Enclosed Arc Lamps.

The purpose of the inner globe, which is a feature peculiar to this lamp, is to surround the arc with an atmosphere of gas which will not support combustion, which it does effectively, although not air-tight, because there is practically no circulation within it, and this atmosphere prevents the rapid destruction of the carbon as in lamps hitherto used.

The oxygen in the outer globe, after long burning, may

be also consumed, but this is the effective limit of the supply of oxygen to the carbon, and taken altogether is negligible.

A test was made of the lamp to determine the duration of the carbons and the quantity of current consumed. The positive carbon, measuring ten and three-eighths inches clear of the holder, demonstrated a life of 160 hours, the current averaging five amperes. During this time the consumption of the negative carbon was one inch. No opportunity was given for a photometric measurement of the light, and it cannot be ascertained, as such measurement has never been made. The length of the arc in this lamp, which is about half an inch, permits a much better distribution of light from the crater of the positive carbon than is possible from the shorter arc of a series lamp. The crater in this lamp is very



Edward's New Electro-Mechanical Gong.—(See next page.)

shallow, and consists of small craters distributed over the entire end of the positive carbon.

The light is remarkably steady, the movement of the carbon being very slow.

The practical advantages of this lamp are:

First. That it can be used singly between mains of any ordinary direct incandescent circuit with comparatively little waste of energy.

Second. That the life of the carbons being so long, the lamp requires trimming only at long intervals—after certainly not less than 150 hours—thus showing a great economy in labor and carbons; this being about twenty times the life of a carbon in arc lamps now generally in use.

Third. The construction of the lamp is of an extremely simple character, with no complication of parts and with little liability to get out of order.

In view of these facts, the Franklin Institute recommends the award of the John Scott legacy premium and medal to William Jandus for his improved arc lamp adapted to incandescent circuits.

Adopted at the stated meeting of the Committee on Science and the Arts, held Wednesday, May 1, 1895.

(Signed) Jos. M. Wilson, President,
Wm. H. Wahl, Secretary,

(Countersigned) Samuel Sartain, Chairman.

The above report will give the reader an idea of the excellence of the Manhattan incandescent arc lamp. The cuts show the general construction of the lamp. The different styles of outward appearance do not materially alter its action, convenience or superiority.

"This lamp has so many new features that are radical departures from existing types, that it is difficult to give sufficient prominence to them all. The lamp is designed to present the following advantages:

One pair of half-inch carbons are guaranteed to burn not less than one hundred and fifty hours.

The lamp will burn singly, with economy, on incan-

descent circuits, avoiding the necessity of placing two lamps in series.

The double closed globes act as a perfect spark arrester, making the lamp fire-proof and absolutely noiseless in burning.

A perfect diffusion of light is obtained by the use of the double globes, doing away with all shadow on the globe and above and beneath the lamp.

Fewness of working parts and decrease in cost of repairs. The mechanism contains neither clock-work, levers, dash-pots, racks, nor carbon rods.

Susceptibility to artistic design.

Entire mechanism concentric to central stem.

Length, 37 inches.

The most important feature of the 'Manhattan' lamp is the use of double globes enclosing the arc, which system is covered by broad and fundamental patents controlled absolutely by this company.

The introduction of the 'Manhattan' incandescent arc lamp on the market represents the most material advance that has been made in arc lighting since the introduction of the series arc lamp in 1878, and stands for a new era in the field of arc lighting. It is very evident, now that the 'Manhattan' lamp has been demonstrated to be a perfect commercial success, that there is no competition possible between a lamp burning one hundred and fifty hours and the old type of arc lamps in which the same carbons will burn but twelve hours."

The illustrations show the various designs at present in vogue.

The standard lamps are furnished from circuits of from 90 to 130 volts (Figs. 12 and 13).

Each lamp may be adjusted for any voltage or current within the above limits. The Manhattan Standard takes from four to seven amperes. The standard lamp is thirty-seven inches long. The "Manhattan Junior" is twenty-four inches long and can he adjusted to take from *two* to *four* amperes.

The Manhattan General Construction Co. have their offices at No. 44 Broadway, New York, No. 753 Monadnock Bldg., Chicago, and 140 Congress street, Boston.

The new electro-mechanical gong, manufactured by Edwards & Co., 144th street and 4th avenue, N. Y. City, is a decided departure from those types now on the market. The hammer is pivoted at the post. When released it makes a *full* revolution, passing under the gong, and is raised by an inclined plane, strikes the gong a powerful, clear blow and drops to its normal position under the gong. After the first blow the armature remains close to the magnets, so that very little power is required to operate it and very rapid blows may be struck.

The smaller sizes, 4 inches to 8 inches, are encased in a polished wooden box with a nickel-plated front, to which is attached the entire mechanism of the bell. By unscrewing this front the whole bell may be removed from the case and the inner parts exposed. Lantern pinions and a very strong spring encased in "main spring box" are used.

The larger sizes, 10 inches to 30 inches, are mounted on a cast frame and entirely encased in polished wooden box, the front of which can be removed, as shown in cut. The wheels are cast bronze and the pinions of solid steel. This style is made to operate by either a spring or weight, and will strike about 500 blows to each winding.

These bells can be arranged to continue striking single, rapid blows until the circuit is broken.

Being dust and damp proof they may be used in exposed places.

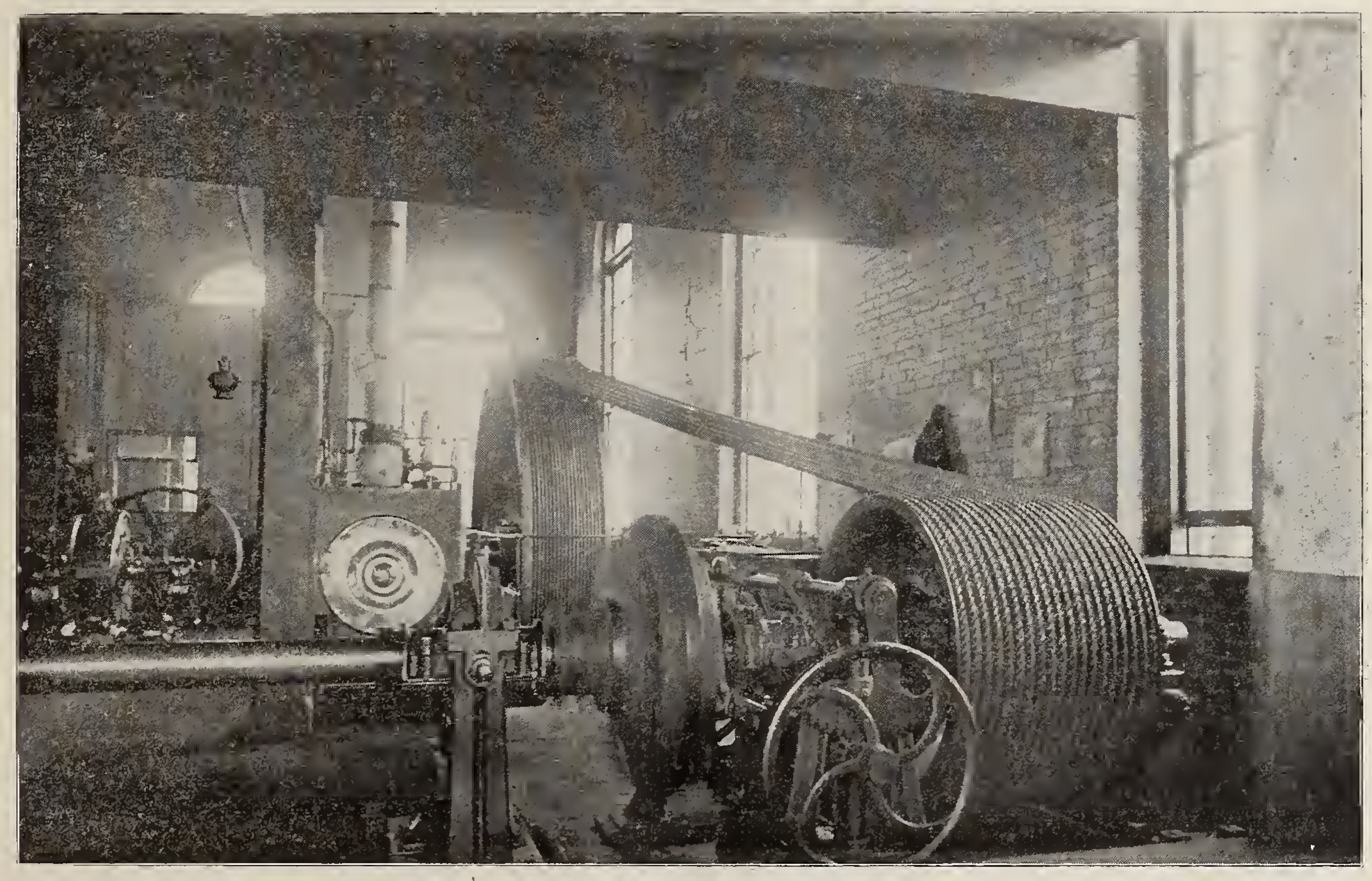
ELECTRIC STOCK QUOTATIONS

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	36	—
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	20
Edison Elec. Illg. Co., New York,	99	101
Edison Elec. Illg. Co., Brooklyn,	98½	100
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	32½	33
General Electric Company pf.,	70	75
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	146	—
Narragansett (Prov. R. I.) Elec. Co.,	81	83
Rhode Island Elec. Protec. Co.,	110	115
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	51	52
Westinghouse El. & Mfg. Co., assd.,	26	28

*Ex dividend.

The Electrical Age.

VOL. XVIII., No. 25. NEW YORK, DECEMBER 19, 1896. WHOLE No. 451



Rope Transmission at the Peabody (Mass.) Electric Light Plant.

POWER FROM CENTRAL STATIONS.

The healthy changes that have been going on in the new field of electrical engineering find their crystallization in the most approved system of transmitting and distributing power. It has been noted by German engineers, and in fact the engineers of every nationality, who visited us at the World's fair, that American machinery was characteristically different from the rest. It seems as though the methods adopted by American engineers has a direct bearing upon the design of their machinery. And it seemed that the lines followed out were not merely those of beauty, but also a rigid adherence to economy and efficiency, in whatever capacity the machines were employed. Americans have likewise reciprocated with their European neighbors. The installation of large units of steam-power in preference to small, and the construction of colossal generators, prove that the work of those in other lands has not failed to leave its mark upon our present, as we think, most modern systems of engineering. Power transmission can be viewed from various standpoints. It is as important a matter for consideration in the station as well as out of it. Lines miles in length, carrying thousands of horse-power, might perform their duties effectively and well, but of what avail would the care and their construction be if within the power-house energy was being frittered away. It seems frequently the pound of coal or the foot pound of water-power have a sad ending in an ill-constructed and inefficient power-house. The seat of trouble, the loss of money and waste of dividends, occurs frequently right here. The line is perfect, the generating station full of grave disorders. Let us contemplate the conditions for a moment that exist in the power-house and the evidence of whose effect becomes noticeable at the delivery end of the line. A boiler, engine and dynamo of the most approved type, or at least a source of power obtained from an equivalently good piece of mechanism as the engine, mark the elements of the modern power-house. We cannot discuss the use of a large engine or many small engines except by saying that a heavy and continuous load would be met best and cheapest by a large engine. It remains for us to consider whether belted or direct-connected engines, or possibly rope-driven engines, are a matter of consequence in the economy of a large installation. The illustrations show a plant set up by the Dodge Manufacturing Co., of Mishawaka, Ind., for the Peabody Electric Light Co., of Peabody, Mass. Their opinion of its high value and satisfaction at its use can be no greater than the figures quoted by Gisbert Kapp, on Herr Beringer's authority, that for distances varying from one hundred to one thousand feet rope transmission equals at least ninety per cent. The point that we have had in view is thus laid bare, that considerable power may be lost between dynamo and motive power on account of the system employed. It is likely that each, whether belt or rope, has its particular benefit under certain circumstances, and it is difficult, or even impossible for anyone to say consistently that one is superior to the other unless the conditions and money to be invested are carefully considered together.

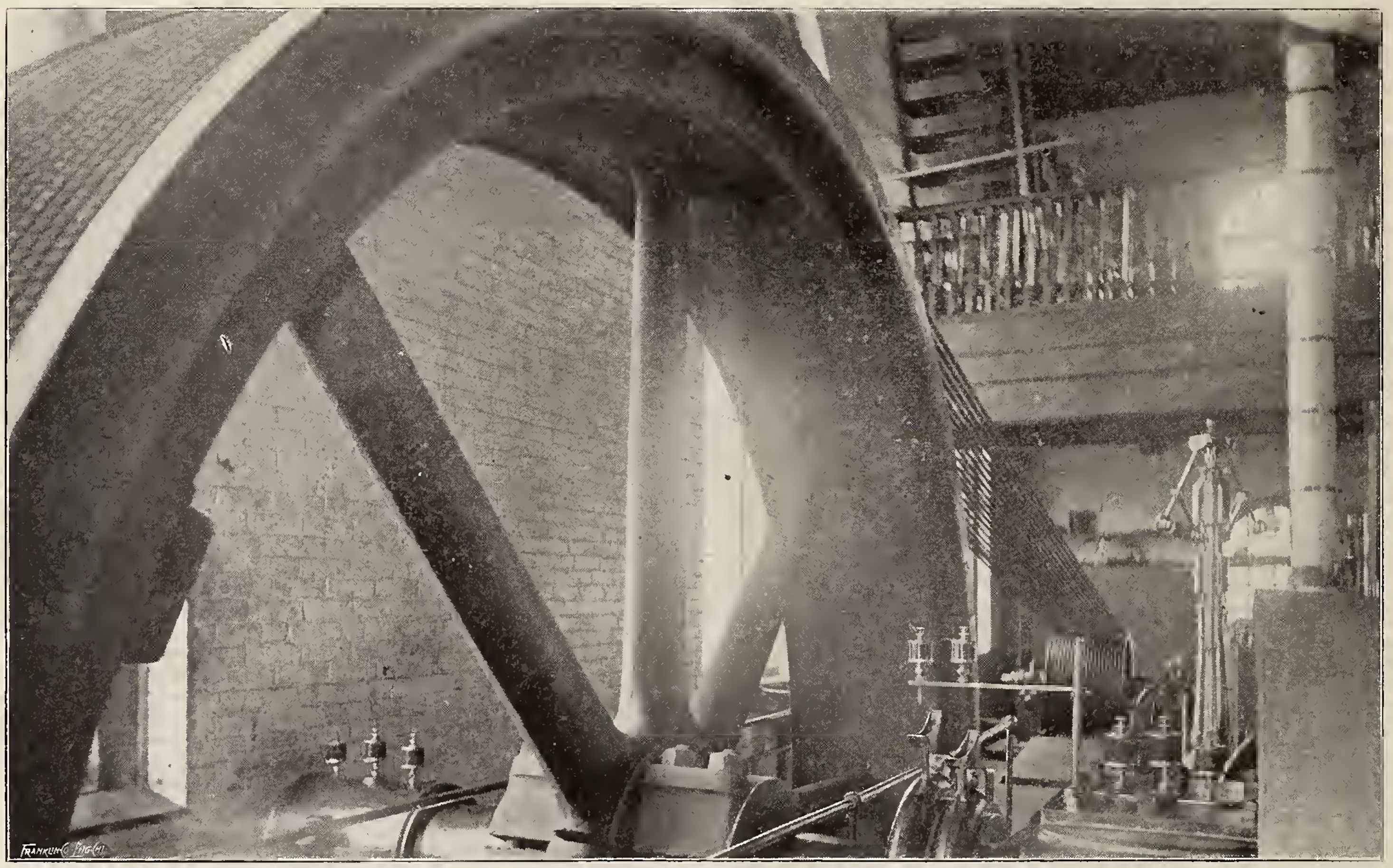
NOTE—We are indebted to "Power and Transmission," of Mishawaka, Ind., for the use of the cuts used with above article.

RUBBER AS A CONDUCTOR.

A western paper takes notice of a decided improvement in the art of electro-plating upon rubber. The following is an equivalent of what the inventor, Mr. Smith, has to say :

"In many of the processes now in vogue for the reproduction in wax of fine engravings or sound records it has been found that there is a loss from the sharpness of the original by moulding the same in wax and depositing a shell of metal, say, copper, by a current of electricity produced by a dynamo or other source of electricity. By my process I overcome this defect, and am enabled to deposit nickel on the non-conducting substance and obtain an exact fac-simile of the design or subject matter with all the fineness and sharpness of lines, dots and impressions that are found in the original; at the same time the nickel forms a hard material, from which copies may be readily obtained with great nicety.

"In carrying out my invention I take a sheet of suitable material, for instance, hard rubber or vulcanite, and place it in a press, to which steam or hot water is ad-



View of Interior of Peabody, Mass., Electric Light Co.'s Station.

Power House, Peabody, Mass., Electric Light Co.

mitted through a pipe for the purpose of rendering the hard rubber soft and pliable. While the hard rubber is in a heated condition, I take the engraving, wood cut, sound record or other form, and press it face downward upon the rubber, whereby the rubber readily takes the impress of the former. The machine is then chilled by cutting off the flow of steam or hot water and discharging what remains in the press through a pipe and opening another pipe and admitting cold water to the press, this admission of cold water occurring while the impression is still on the mould of hard rubber, in order that any contraction of the hard rubber while chilling may take place while the impression is still on.

(To be continued.)

SOME ACCOUNT OF THE EVOLUTION OF THE INDUCTOR ALTERNATOR.

(Continued from Page 734.)

In 1887 Mordey cut the Gordian knot by entirely suppressing the iron in the induced portion of the machine. The highly and deservedly successful machine that bears his name is shown in Figures 15 and 16.

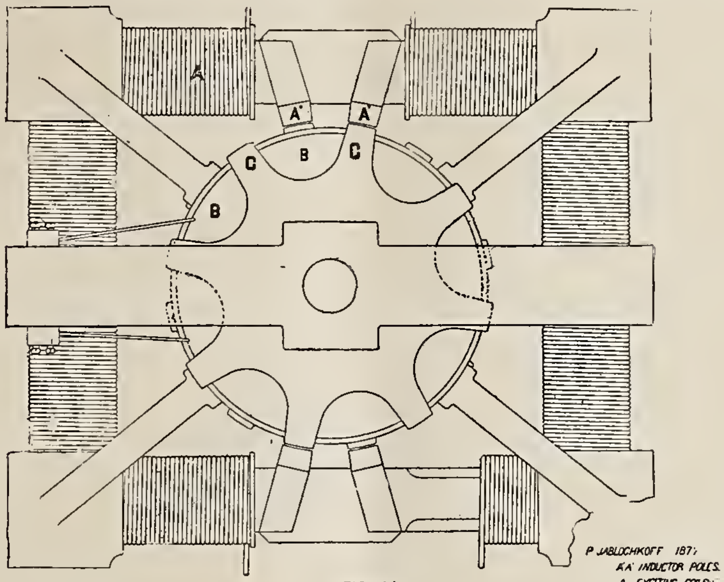


FIG. 14.

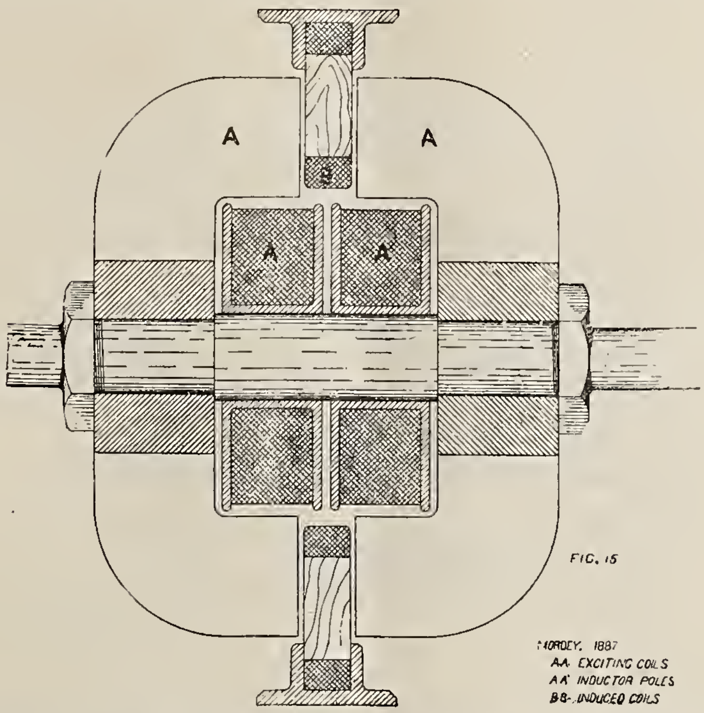


FIG. 15

There is a central core surrounded by the exciting coil A. From each end of this core projects a set of radial polar arms, which are recurved so as almost to meet one another. In the space left free are mounted the thin induced coils BB in a circle. The induced coils are wound in the plane of this circle, and are in number

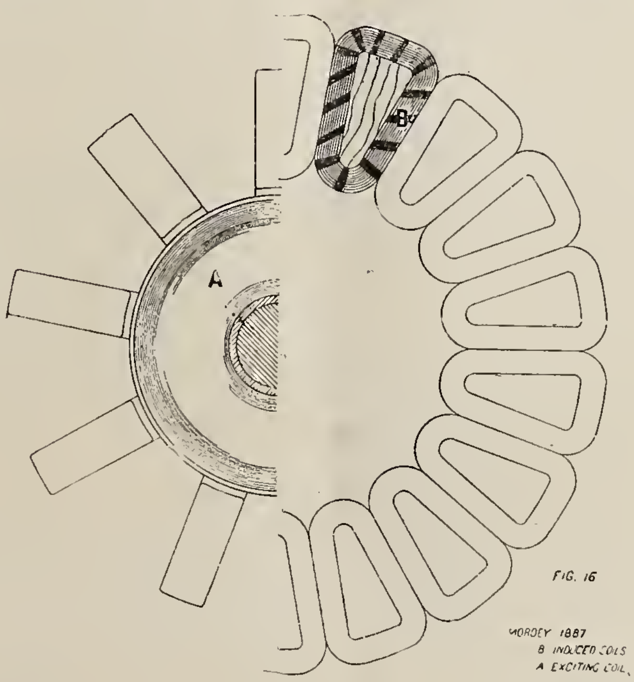


FIG. 16

twice the polar faces on one side. The induced coils are fixed and the inducing magnet revolves. The exciting coil turns with the core, but this is electrically immaterial, and the results would be the same were it at rest. Obviously, the total reluctance of the magnetic circuit is the same, no matter what the position of the inductor. Change of flux in the iron is due only to armature reaction, and it gives rise to iron losses only because of its space variations. With a low armature reaction, such losses will be extremely small.

Mordey's success, instead of putting an end to attempts to build inductors with iron in the induced portions, gave rise to a new series of efforts. Indeed, Mordey himself was foremost. His English patent of 1887, relating to the coreless armature machine, also described a machine with cores, and in subsequent patents he describes the machines shown in Figures 17, 18, 19 and 20.

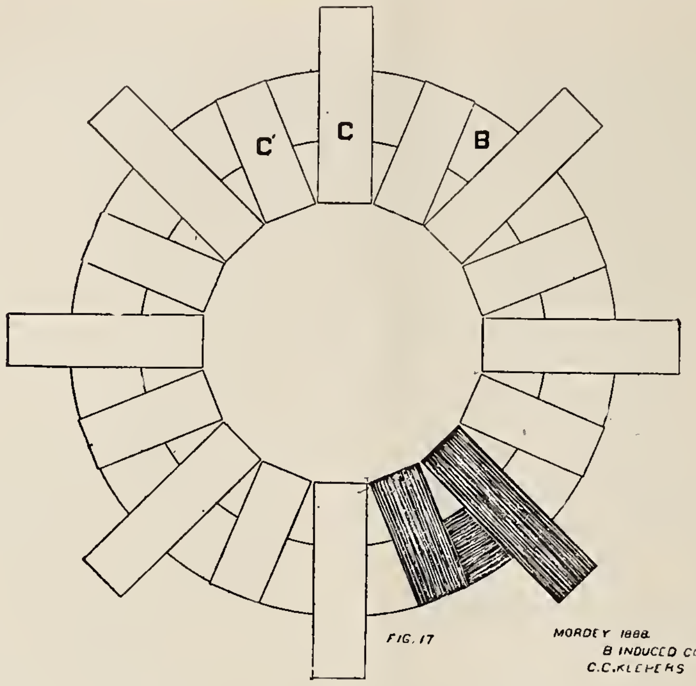


FIG. 17

MORDEY 1888.
B INDUCED COIL
C.C. KEEPERS

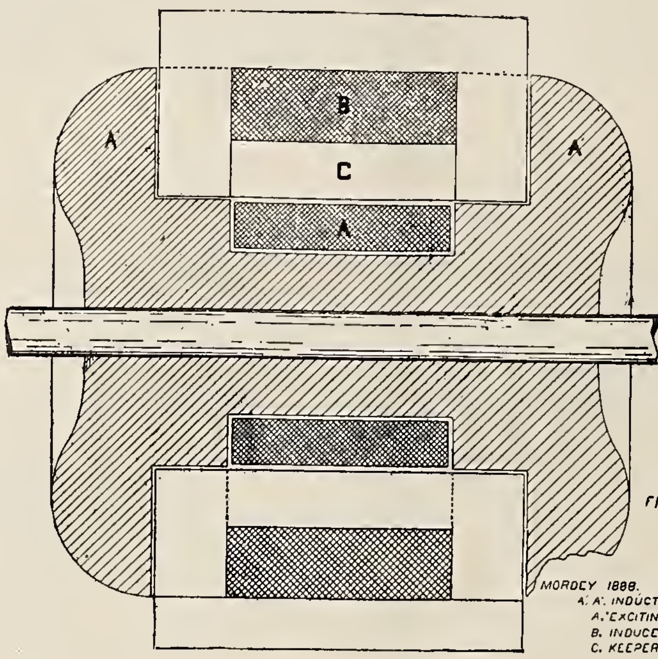


FIG. 18

MORDEY 1888.
A' A'. INDUCTOR POLES.
A. EXCITING COIL
B. INDUCED COIL
C. KEEPER.

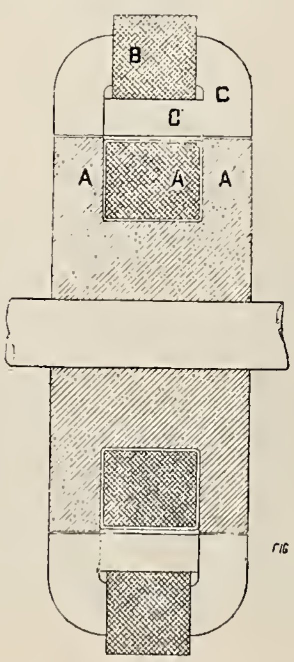


FIG 19

MORDEY 1889
A EXCITING COIL
A' A' INDUCTOR POLES.
B INDUCED COILS.
C C'. KEEPERS.

These machines have not come into use, and, presumably, they are not as satisfactory as the coreless machine. Yet they show a marked advance when compared with the older machines. The use of the short-circuiting pieces C', as well as the bridges C, tends to make the flux con-

stant in amount and to restrict the magnetic changes to the induced portions of the machine. The iron subject to magnetic change is also properly laminated to prevent Foucault currents. The most obvious fault in the designs is that the mass of iron in the induced portions is large, and that all of it is subject to hysteresis loss.

In passing, it may be worth while to note one peculiarity of single induced coil machines like the earlier of the Mordey designs. With any given frequency the output is independent of the speed; or, in other words, the only limit to reduction of speed is the possibility of further subdividing the poles. For, with the number of poles increased N times, the total change of flux takes place with 1/Nth the angular motion. This remarkable property may some day bring about the introduction of machines of this class for direct connection to very slow-speed engines.

(To be continued.)

LIST OF MACHINES SHIPPED BY THE AMERICAN ENGINE CO., OF BOUND BROOK, N. J., DURING NOVEMBER, 1896.

18-K. W. dynamo, Syracuse Post, Syracuse, N. Y.
50-K. W. dynamo, Evening Star, Washington, D. C.
25-H. P. motor, Springfield Union, Springfield, Mass.
12-H. P. motor, New York Tribune, New York City.
12-H. P. motor, Peoria Herald, Peoria, Ill.
12-H. P. motor, Duluth News Tribune, Duluth, Minn.
1 8-in. x 8-in. engine, Leavenworth Times, Leavenworth, Kas.
5-H. P. motor, St. Paul Pioneer Press, St. Paul, Minn.
10-in. x 10-in. engine and 50-H. P. boiler, Chinese government.
25-K.W. dynamo, The Morning News, Savannah, Ga.
5-H. P. motor, Salem Daily Gazette, Salem, Mass.
12-H. P. motor, Chicago Journal, Chicago, Ill.
50-H. P. motor, Boston Daily Post, Boston, Mass.
75-K. W. dynamo, Kansas City Star, Kansas City, Mo.
12-H. P. motor, W. D. Boyce & Co., Chicago, Ill.
14-in x 12-in. engine, J. Harper Bonnell Co., Long Island City, L. I.

Editor of Electrical Age:

Your sample copies received. I am very much pleased with your paper, having received eight samples of other papers, and found yours my choice. Enclosed find check for $1.25 to pay for the Electrical Age for six months, commencing with November 14. Hoping soon to receive your valuable paper at the above address,

I am, yours very truly,
Henry H. Risley.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTICAL ENERGY.

BY LOUIS DUNCAN.

Continued from Page 713.)

In New York, Brooklyn, Boston and Chicago a large proportion of the direct current lighting stations are situated where it is expensive to handle the coal and ashes, and where the economy, due to condensation, is not obtained. It is also the custom to use several stations instead of a single large station, and this increases the cost of production both in operating expenses and fixed charges. The question arises whether we have reached a point where it will be more economical to consolidate the stations in the best possible location for economical production of energy, and make use of the means of distribution which have been developed in the last few years to increase the radius at which energy can be supplied.

As far as traction stations are concerned, their efficiency and output would be increased by the use of batteries, both because the machinery would be steadily loaded and because the most efficient type of apparatus could be used, as is the case in lighting stations. By the consolidation of railroad properties that has taken place in the last few years single corporations operate electric

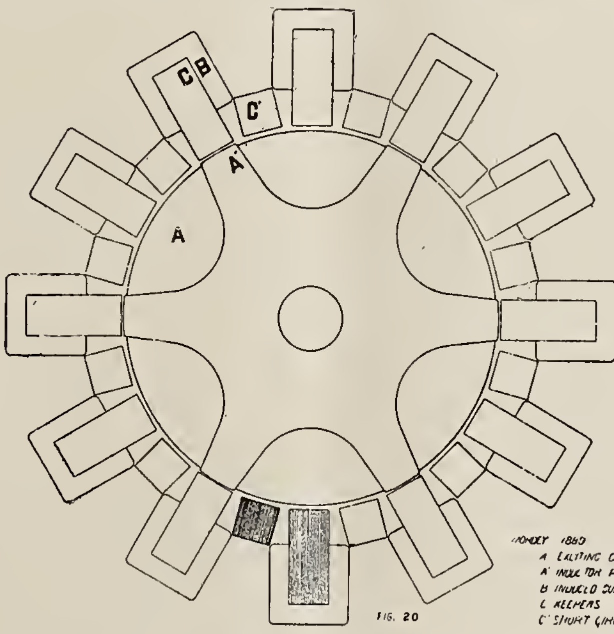


FIG. 20

lines over extended areas. It is the custom to build a number of stations, each running a certain section of the line, the idea being that the decreased cost of copper and the decreased possibility of a shutdown would more than compensate for the increased cost of operation and fixed charges. It is, again, important to consider the question whether we have not reached the point where a single station can be built in such a way that there is little or no possibility of any accident causing a suspension of the entire traffic of the system, and where improved methods of distribution will decrease the amount of copper so that it will not exceed that required by the present method of using a number of generating stations.

If storage batteries are used the two types of variable load belonging to lighting aud power stations demand different types of battery. For lighting stations a considerable capacity is required, while the momentary variations of power stations do not require any great capacity, but demand as great a maximum output as battery manufacturers can obtain.

In water-power plants the conditions of economy are different. The location of the plant is, of course, definitely fixed, and the advisability of obtaining a uniform load, by means of batteries, depends upon the local conditions. If the water-power is limited and is less than the demand, then it might be well to use batteries in order to increase the amount of salable power. Again, if the de-

velopment is expensive, it might be cheaper to develop a smaller amount of power, pay for a smaller amount of machinery, and increase the output by the addition of batteries. These are questions that can only be decided by a knowledge of the local conditions.

We may conclude that while the practice in large lighting and traction systems is to multiply stations near centres of consumption, yet the economy of a single large station makes it important to consider whether it is not possible to concentrate our power at some point where the expenses will be a minimum and distribute by some of the methods which have in the last few years proved successful and economical. It is important to make the station load steady, and this may be done for continuous current lighting and traction plants by means of storage batteries.

ELECTRICAL DISTRIBUTION.

The distribution of electrical energy to consumers as distinguished from its transmission to long distances, has been largely accomplished by the agency of continuous currents, although alternating currents have played an important part in incandescent lighting. As I have stated, a considerable proportion of current for lighting is distributed at constant potential on the three-wire system, or at constant current on arc light circuits, while power for traction circuits is distributed at approximately constant potential at an average of say 550 volts.

I shall first consider the condition of affairs in a traction system in a large city, where a number of suburban lines are operated. If direct distribution is attempted from a single station, it will be found that when the distance exceeds five or six miles a large amount of copper must be employed to prevent both excessive loss and excessive variation of potential on the lines. On suburban lines it is the latter consideration that usually determines the amount of copper used, and this is especially true on lines where there is a considerable excursion traffic. Even in the city itself, the supplying of sections at distances three or four miles from the station may require so much copper that it would be less expensive to operate separate stations. Several methods other than the direct method may be employed to remedy these difficulties. For outlying lines where the traffic is mainly of the excursion order, being variable both during the day and for different seasons, boosters may be advantageously used. It is perhaps best from reasons of economy to run the boosting dynamos from motors. These dynamos are series-wound and are connected to feeders of such resistance that the fall of potential in the wire for a given current is compensated. or by the rise in voltage of the booster. There is a decreased cost of copper incidental to this system, due to the fact that the drop is not limited by considerations of regulation—the voltage at the end of the feeder being constant—while the transmission is at an increased potential. If the average station potential is 600 volts, and it is boosted 300 volts, then the copper for a given loss would be decreased in the ratio of 36 to 81. The booster system has the advantage of the direct system when the cost of the additional apparatus together with the increased loss on the line, capitalized, is less than the increased cost of the copper necessary to produce the same result by the direct system. Whether the balance is in favor of one or the other depends on the distance and the variation of the load, and it is indifferent whether the variation in the latter occurs often or not.

(To be continued.)

Shiff, Jordan & Co., No. 39 Cortlandt street, received a ship-load of their popular arc light carbons last week. The number equals half a million. They are all sold, but another ship-load is on the way. Mr. N. E. Frorup is still travelling through the East and hustling in big orders.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—ELECTRIC COOLERS.

Spokane Falls, Dec. 2, 1896.

Electrical Age Pub. Co.

Dear Sirs:—What information can you give me in relation to electrical ice coolers? I have read of them in some text-book, and would like your opinion as to their practicability.

Yours respectfully,

Edwin Butterworth.

(A.)—The use of an electric ice cooler would be expensive. Of course, that at once implies their use as a possibility. The Peltier effect, caused by a current cooling the junction of two dissimilar metals, would be the principle of construction. If electricity is cheap enough, in any case it might be an excellent field to investigate, even on a purely commercial basis.

(Q.)—CONDUCTION AND INDUCTION.

Washington, Dec. 6, 1896.

Editor of Inquiry Column.

Dear Sir:—Can a conductor conduct and at the same time be affected by induction? I am of the opinion that induction with a static charge is different from induction with a current. If this is so, let me know and you will oblige.

Yours truly,

Max Elbers.

(A.)—A conductor may carry a current and be affected by induction at the same time. Your opinion is correct. Induction with a static charge is different from induction with a current. The first is the result of a stationary charge, the affected body being motionless likewise. The other is only produced by magnetic changes.

(Q.)—DESTRUCTION OF LAMPS.

Los Angeles, Nov. 30, 1896.

To the Editor.

Dear Sir:—The electric light plant out here is running smoothly, but the lamps break very rapidly. I thought that this was due to the alternating current we use. Would you kindly state the causes which effect the breakage of lamp filaments?

Yours very truly,

Augustus Trumme.

(A.) The alternating current may possibly damage lamp filaments a little more than a continuous current. The likelihood is, however, small that your plant is thus affecting the lamps.

Excessive voltage,
Mechanical vibration,
Varying pressure,

cause rapid fracture of the filament.

(Q.)—BEST POINT OF CUT-OFF.

St. Louis, Dec. 3, 1896.

Electrical Age Pub. Co.

Dear Sirs:—Your Inquiry Column has been so advantageous to me that I beg your patience in asking a question. In running an engine for electric lighting, what is the best point of cut-off? That is to say, is it one-fifth, one-quarter, etc., or does it depend entirely upon the load? Kindly reply when convenient.

Yours respectfully,

Simon Paul.

(A.)—The point of cut-off is best determined by the average load. It should be sufficient to do the work and yet lie within the limits of economy. The make of the engine and its working pressure likewise affect the general result. A card taken at full and half load would render a decision of some value.

The Electrical Age.

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CONTENTS.

EDITORIALS
The Longevity of the Cable 747
X Rays in Surgery 747
GENERAL SUBJECTS
Power from Central Stations 741
Some Account of the Evolution of the Inductor-Alternator 743
Present Status of the Distribution and Transmission of Electrical Energy 745
Galvanometers 748
Dynamo Building by Amateurs 751
MISCELLANEOUS
Rubber as a Conductor 742
Cable Must Go 754
TRADE ARTICLES
List of Machines Shipped by the American Engine Co., of Bound Brook, N. J., during November, 1896 745
Bergmann Improved Inclosed Arc Lamps 753
Thomas J. Fay and Associates 753
Vulcan Torch 754
Customers of the Manhattan Arc Lamp 755
Possible Contracts 755
INQUIRY COLUMN 746
New Corporations 755
Telephone Companies 755
PATENTS 756
ELECTRIC STOCK QUOTATIONS 756

THE LONGEVITY OF THE CABLE.

It has been said by many that New York City is behind all others in its systems of surface traction. Cities of comparatively youthful age have installed in them prior to all else traction systems of considerable size and capacity. A conservative spirit that is almost English in its character is one of the marked peculiarities of New York. Yet, when we come to review the traction systems that New York really possesses, we cannot fail to realize that, at present, it is in all probability more progressive than the other cities of the Union. Within the city's confines may be found the ordinary system of electric traction with overhead trolley, the open conduit system with underground trolley, the composite system covering both storage battery and block and the storage battery simple and alone. It is evident that a fair test is being given to these methods of street car propulsion; those which fail to operate successfully can never hope to supplant the cable. Systems that are being tried will, in the near future, be pronounced capable or not of meeting the demands of city practice. It is this fact which leads us to believe that New York will, in the course of time, represent in its surface roads the best system for large cities. A false impression that occasionally prevails is that the cable will soon be a landmark. We understand that the cable roads in New York were laid down only after all other means of traction, including compressed air, had been carefully reviewed. The cry against overhead trolleys is loud and fierce, the underground trolley not having had a chance to show its scope or usefulness at so interesting a period, and it was therefore deemed advisable to install the cable. The New York press states that the cable must go, but it is doubtful whether it will go as rapidly as they anticipate. Yet it is likely that the substitution of an electric road for the present cable system will eventually take place. This will be when the superiority of an electrical system from various economical and engineering standpoints is a matter of not even the slightest doubt to the financiers of the various cable roads. Whatever discussions otherwise occur on the subject are but foreshadowings possessing no greater significance than that they herald a contemplated change. If a road were in operation in this city working by compressed air its chances of success, like that of the others, would depend entirely upon its own merits And it is therefore this series of tests which, to our mind, will eventually determine the longevity of the cable.

X-RAYS IN SURGERY.

All diseases possess characteristic symptoms. The location of disease is greatly facilitated by the use of X-rays, that is to say, malformations of the bone or diseases within the bone, or the presence of tumors and cancers. These last are occasionally spoken of in connection with X-rays as having been found by them. Recent experiments made in the physical laboratory of the University of Michigan by men of repute lead us to believe that the living pulsations of a man's heart have been clearly seen. The heart is the most mysterious organ that we possess, and its beatings even in a lower form of life has upon observation left the beholder in awe. The systematic motion of that organ, beyond our power of volition to control it, is one of the most remarkable, if not the greatest of the phenomena of life. The extraordinary results obtained by means of X-rays in showing the heart beat may be classed as one of the greatest triumphs of the age. Cases have occurred in which the heart was seen beating, but these were the result of accident or laceration of the flesh. Diseases of the heart will henceforth be diagnosed, and in fact of any organ or part of the body, provided the tissues or the bone are sufficiently affected to call for their use. X-rays and medicine will bear the closest relation to each other in the near future, such that a physician will only be classed as truly competent when his knowledge of electrical principles and their application is complete.

THE DE LAVAL ELECTRIC FURNACER.

(American Manufacturer and Iron World.)

The new progress which De Laval, the Swedish engineer, has invented for the conversion of iron ore into pure metallic iron or into steel is attracting attention for several distinct reasons the principal one being that he will attempt to accomplish in one operation what it usually takes two to perform, namely, the complete elimination of the impurities associated with the metal as found in the earth. Instead of producing pig iron first, and then converting this into commercial iron or steel bars, the ingenious Swede completes the job with a single heating. Then, he proposed to employ electricity in his work on a collosal scale, and for that reason he and other capitalists whom he has associated with him are buying up a lot of the best water powers in Sweden.

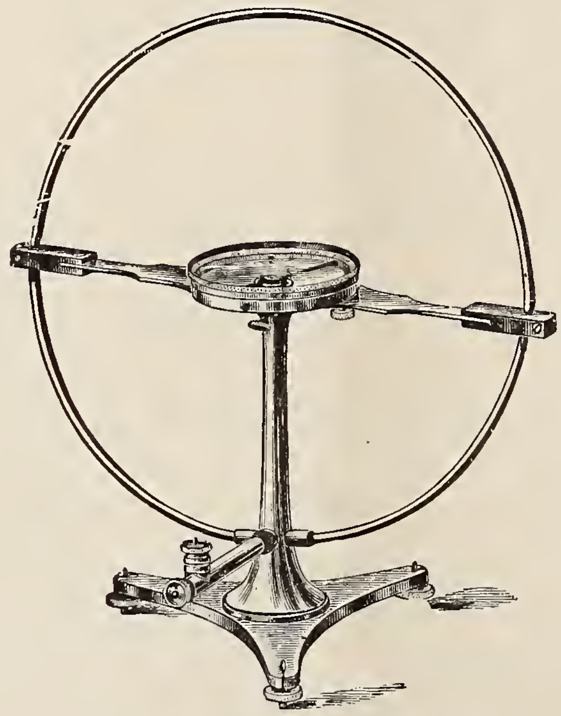
Electricity is already used in large quantities in the purification of Montana copper and the production of aluminum at Niagara and Neuhausen. But the processes in both cases are different from that which is involved in the new system of reducing iron ore. They are chemical in their nature, and effect a disintegration of substances dissolved in a bath through which a current is sent. What De Laval does, on the other hand, is merely to produce heat, precisely as is done in an electric welding machine, an electric cooking range, or one of those tiny furnaces in which M. Moissan manufactures diamonds.

GALVANOMETERS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

An instrument originally intended for the detection of currents was the basis from which sprang the subsequent types of galvanometers. The mere detection of a current did not give the galvanometer any important position in the world of science, but when its function as a means of measuring amperes, volts and ohms became evident the various styles of meters appeared and the laboratories considered their use indispensable.



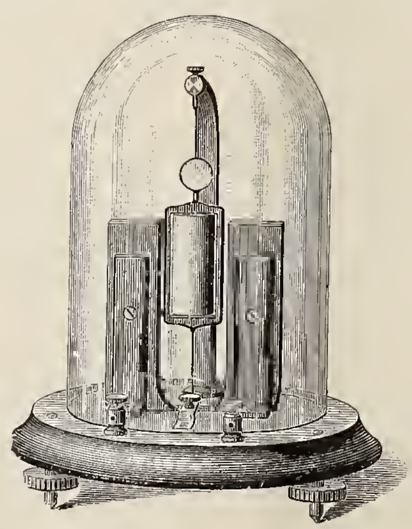
Simple Tangent Galvanometer

A galvanometer consists essentially of a coil of wire and a magnet arranged in such a manner that the passage of a current in the coil moves either one or the other according to its adjustment.

The galvanometer may therefore be an instrument in which the coil is rigid and the magnetized needle free to move, or the needle fixed, in which case it would have to be very large and the coil movable.

An artificial magnetic field.—It is usual to supply galvanometers having one needle with an artificial magnetic field, that is, have an arched magnet capable of side and up and down adjustment placed over the galvanometer, for the purpose of neutralizing the magnetic field of the earth, which would tend to drag upon the needle at times and destroy its sensitiveness.

To understand the use of this curved magnet, imagine a magnetized bar suspended by a cord in the air. The earth would tend to set it pointing north and south. This is due to the magnetic field of the earth. If this field is neutralized the bar will remain indifferently suspended, taking no particular position. A weaker force will then move it than before, so that if a small needle be considered that is being similarly treated, as in a galvanometer, it will take but a weak current to deflect it from its position. The arched magnet acts as a directive force if the galvanometer is "astatic."



D'Arsonval Galvanometer.

The deflection of the needle is due to the effect of the magnetic field (produced by the coil when current flows through it) upon the needle.

The more intense this field, the greater the twist or deflection of the needle. For the sake of convenience, heavy currents are measured in galvanometers of few turns but large sized wire, and weak currents in galvanometers of many turns and fine sized wire.

The classification resulting is therefore—

Low resistance galvanometers,
High resistance galvanometers;

or, as they are sometimes called,

Short coil and
Long coil galvanometers.

It makes but little difference whether a heavy current

of low pressure or a weak current of high pressure affects the needle, certain facts are common in either case.

(1.) The delicacy of the galvanometer is dependent upon the method of suspension.

(2.) Upon the strength of the coil.

(3.) Upon its object.

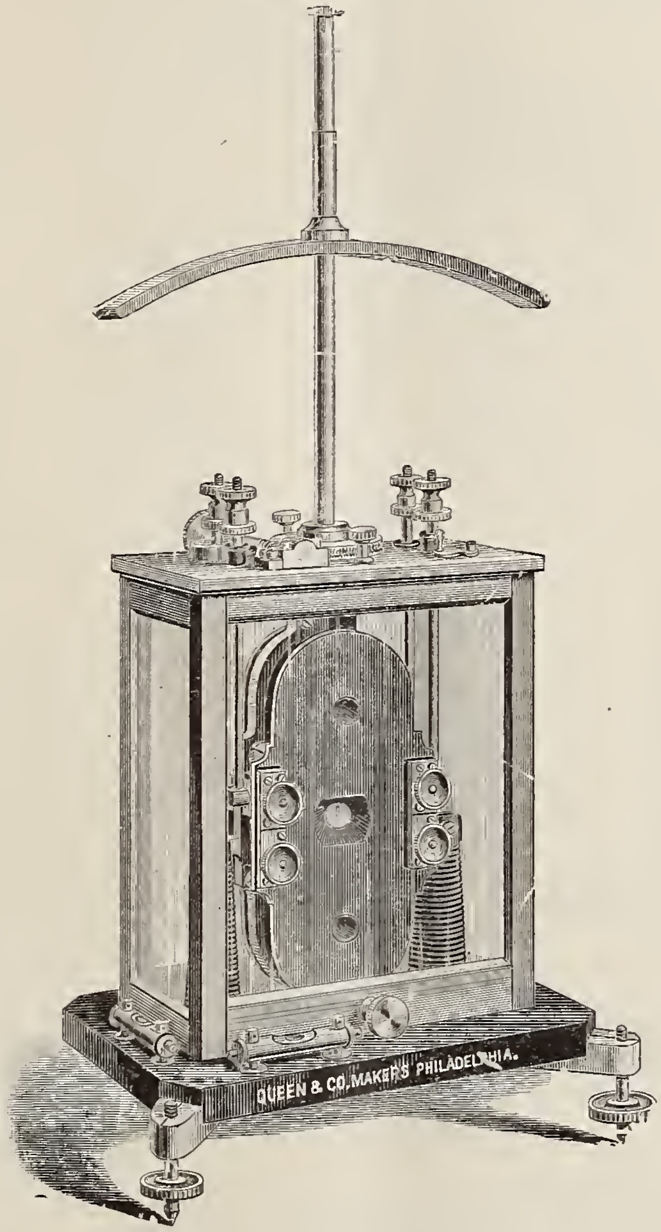
As a rule the galvanometer in practice, either in laboratory or regular outdoor service, is made "astatic."

Astatic needles are merely two magnetized needles of equal strength placed upon a rigid bar, with *opposite* poles pointing in the same direction. One needle swings *inside* the coil, the other *outside* in unison with the first, because of its permanent connection with it. A galvanometer may have as many pairs of needles as it has coils, or it may have one in each coil.

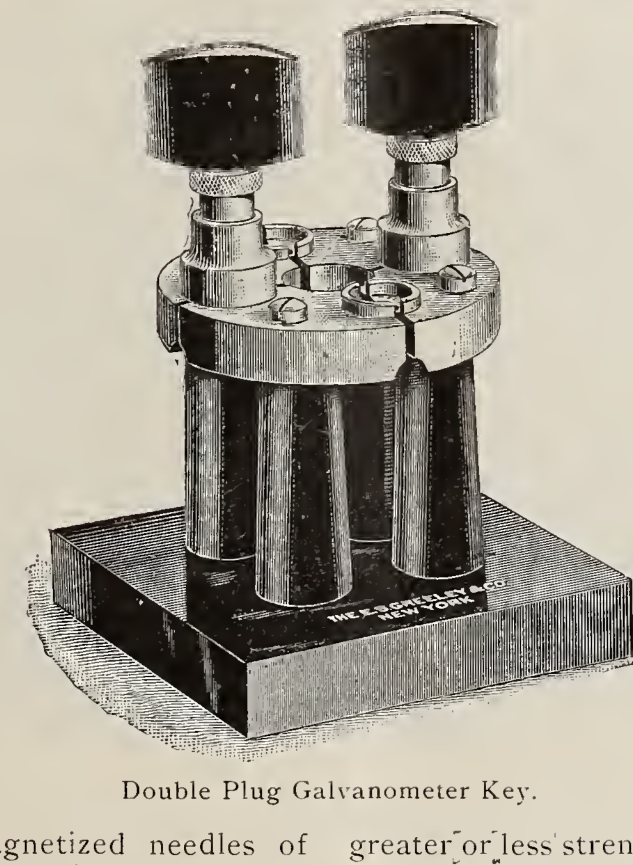
The two needles, being of equal strength, practically neutralize each other. The earth does not exert any directive influence over them any more than if they were of neutral metal.

The arched magnet may supply an artificial field of greater or less strength as desired, by bringing it closer or further away from the coil.

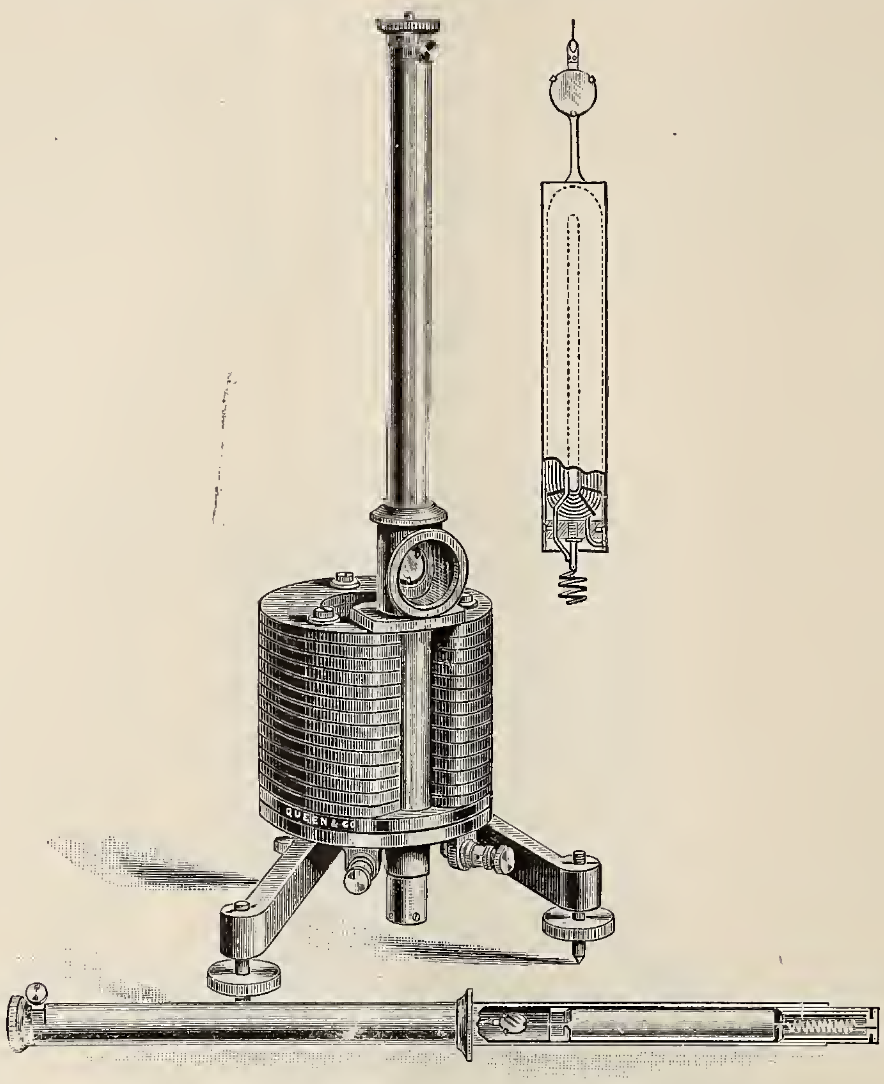
A galvanometer constant is of consequence in determining the delicacy of the instrument.



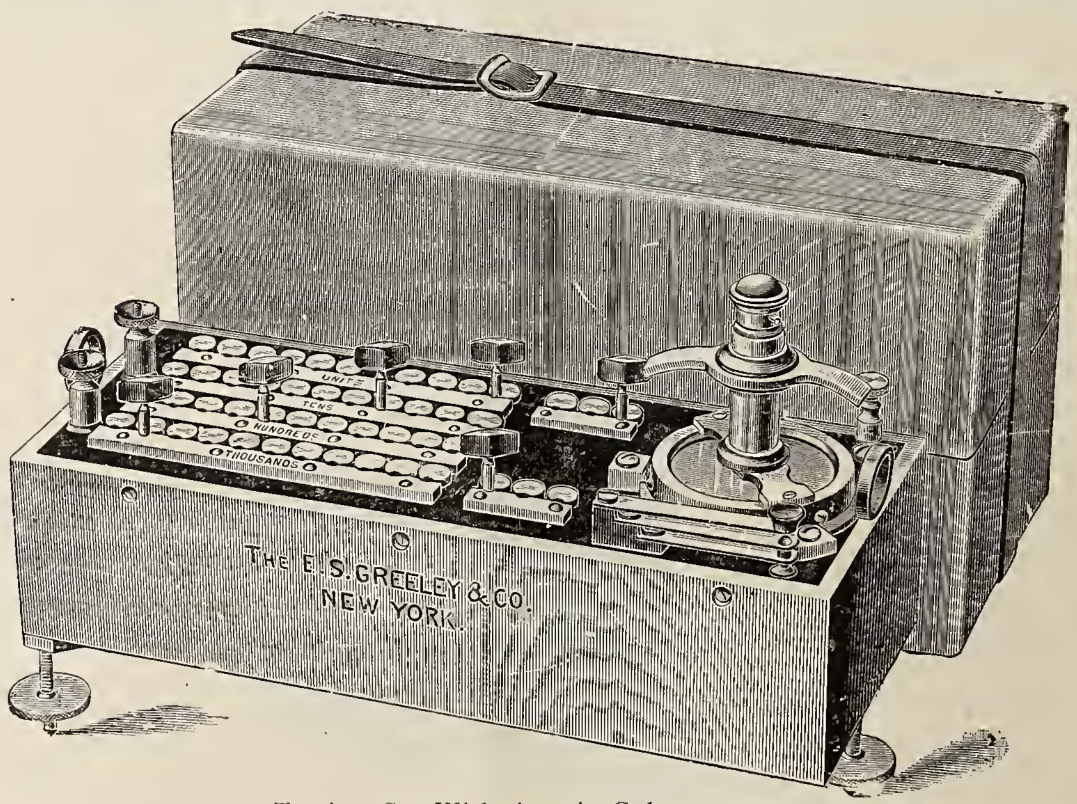
Double Coil Astatic Galvanometer.


Double Plug Galvanometer Key.

As a rule *mirror reflecting* galvanometers are in use for testing. They were invented by Lord Kelvin, of England, for receiving signals over the Atlantic cable—a small coil, within which swings a bit of magnetized watch-spring stuck to the back of a concave mirror about three-eighths of an inch in diameter. A beam of light strikes the mirror from a slit in a scale placed about three feet away. When the needle is at rest, the mirror reflects the spot of light on the middle of the scale. The least change in the coil makes the needle swing either to one side or the other. By this arrangement a pointer is dispensed with, the beam of light being its substitute.



Ballistic Galvanometer.



Testing Set With Astatic Galvanometer.

In a mirror galvanometer the current and the deflection increase or decrease together in uniform proportion.

The constant, or figure of merit, of a galvanometer, is the amount of current required to produce a deflection of one division on the scale.

It is found by connecting an adjustable resistance coil and a battery in series with the galvanometer. The resistance must be added to until the spot of light marks one division. By applying Ohm's law the current flowing is easily found.

If volts of battery = 1,

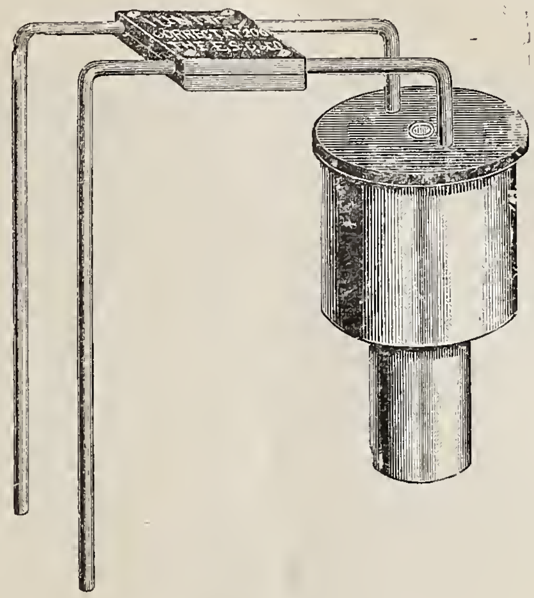
Total ohms in circuit = 10,000,

the current flowing, therefore, = $\frac{1}{10{,}000}$ = .0001 of an ampere. When one is divided by 10,000, Ohm's law is applied.

$$\text{Current} = \frac{\text{volts}}{\text{ohms}} = \frac{1}{10{,}000}.$$

One division deflection is due to .0001 of an ampere, which is the figure of merit or constant.

A heavy current in a sensitive galvanometer would throw the spot of light off the scale.



Standard Ohm.

An arrangement is used which divides the current up, so that only part enters the galvanometer ; the rest passes away in what is called a "shunt."

A shunt takes only a certain amount of the current, as its construction calls for

$\frac{9}{10}$ of the current,
$\frac{99}{100}$ of the current,
$\frac{999}{1000}$ of the current.

This is done by making the shunts of a resistance equal to $\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ of the resistance of the galvanometer coil.

The galvanometer and shunt then take an amount of current that can be determined by Ohm's law. For instance, if a

Galvanometer has 1 ohm resistance,
Shunt $\frac{1}{9}$ of an ohm,

with a one-volt battery,

$$\text{the galvanometer would take } \frac{1 \text{ volt}}{1 \text{ ohm}} = 1 \text{ ampere;}$$

$$\text{the shunt would take } \frac{1 \text{ volt}}{\frac{1}{9} \text{ ohm}} = 9 \text{ amperes}$$

Total, 10 amperes.

Galvanometers serving various purposes are named as follows:

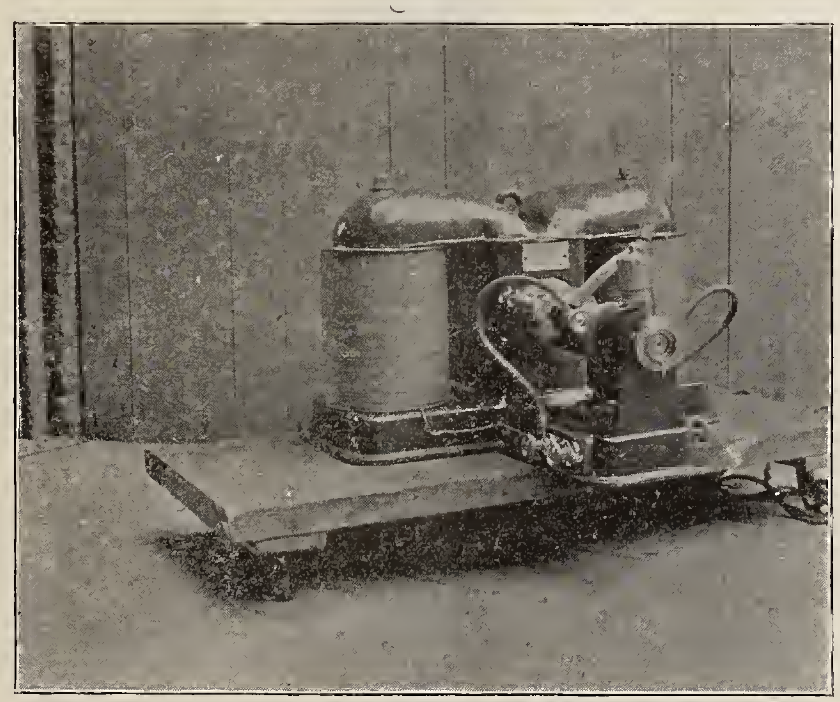
Tangent galvanometers,
Sine galvanometers,
Astatic galvanometers,
D'Arsonval galvanometers,
Ballistic galvanometers.

The Weston instruments are patterned after the D'Arsonval galvanometer.

The detection and measurement of the current and pressure lie within the field of the galvanometer. For the measurement of resistance another department is required, that is vast in its extent and of the greatest importance.

DYNAMO BUILDING BY AMATEURS.

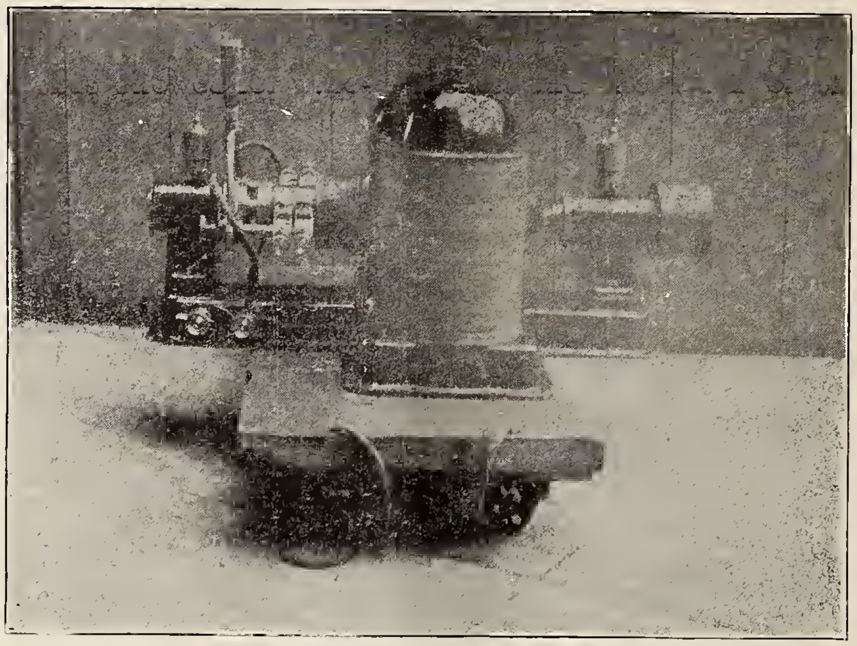
A pupil of the American School of Electricity, Mr. Jacob Ruf, engineer for Charles Schuetz's Sons, Mulberry street, Newark, has designed and constructed a 26-ampere, 110-volt dynamo which is at present in daily use at the factory. The value of the instruction received from the school is spoken of enthusiastically by Mr. Ruf, and he promises to build another machine for 100 lights in the near future. Mr. C. E. Appleby, another pupil of the American School of Electricity and graduate of the course in dynamo design, is completing a 100-light, 50-volt dynamo for lighting the factory. He is superintendent of the Zinc Reduction Company, of Jersey City, and attributes all his knowledge of the subject to the excellent and systematic training he has passed through in the practice and principles of the subject.



50-Light Dynamo Built by Jacob Ruf, Member.

Out of a total of 10 amperes the galvanometer takes 1 and the shunt 9; therefore the shunt, having $\frac{1}{9}$ the resistance of the galvanometer to which it is connected, takes $\frac{9}{10}$ of the current.

The evenings that might have otherwise been wasted are put to the best use by the pupils of the American School of Electricity, without more than a nominal cost and the least expenditure of time. The following data of Mr. Ruf's machine was recently supplied to us by him. The other dynamos spoken of will be illustrated on receipt of photographs, etc.:



Another View of Jacob Ruf's Dynamo.

Fifty-light Shunt Dynamos,
110 volts,
26 amperes,
2,000 revolutions,
Bipolar Manchester Type.

The armature is made up of laminæ of No. 26 sheet iron, turned down to 5¼ inches in diameter, and 9 inches long. The shaft is 32 inches in length, the part within the core being 1¾ inches in diameter, for greater body. Five inches was allowed for each bearing, 4 inches length for the commutator, of 1¼ inches diameter, and 3 inches for the pulley. Space was thus allowed for winding and for the armature heads. The wire on the armature is No. 14, double cotton-covered, wound in 44 sections of four turns each. The entire weight of wire is 7½ pounds. The thickness of the armature heads is 2½ inches on each side. The armature is smooth core and has a diameter over all, with winding, of 5¾ inches, and a total length of 13 inches.

The commutator is made of drop forgings; it consists of forty-four sections, with mica insulation, is 2½ inches wide and 3 inches in diameter. Gauze brushes are used.

The field magnet coils are made of 100-pound No. 17 single cotton-covered wire wound on brass spools 5 inches in diameter and 10 inches long. Each coil has 31 layers of 180 turns in each, or a total on both coils of 11,160 turns. The fields take 1.25 amperes at 110 volts. The finished coil is 8 inches in outside diameter and encloses a round core 5x10 inches, made of wrought iron. The pole-pieces are of cast iron, to which the core is bolted both above and below. The bore of the field is 5⅞ inches, and the width of the pole-piece is 6½ inches.

Bergmann Improved Enclosed Arc Lamp.

The pole-pieces are a distance of 2 inches apart and project beyond the frame 1½ inches on each side. The frame above the fields is 6 inches wide and, over the armature, 9 inches. The bearings are 1¼ inches in diameter, 5 inches long, and are fitted with the Hyatt flexible roller bearings.

Jacob Ruf,
Pupil of the Newark class of the American School of Electricity.

BERGMANN IMPROVED INCLOSED ARC LAMPS.

Many improvements have been made in arc lamps for incandescent circuits. The General Incandescent Arc Light Company, 572–578 First Avenue, New York, have been manufacturing arc lamps for incandescent or low tension direct-current circuits for a number of years and have met with great success. Several months ago they placed their inclosed arc lamp on the market, hundreds of which are in use, giving the best of satisfaction. The General Incandescent Arc Light Co., with their usual advancement, have since added some valuable improvements to their inclosed arc lamps which we take pleasure in placing before our readers. They have an improved method of fastening the inner and outer globes, overcoming any breakage so often the result of careless handling. The inner globe, or bulb, is held in place by a special holder and ring screwed to a seat on the base of the lamp; the upper and lower carbons are renewed without removing the inner bulb, but by simply moving a cap at the base of lamp.

The outer globe is held in position by a bayonet lock, and is held firmly against the spark arrester after it is placed in position. They have lately sold 150 of these lamps to a printing establishment in this city, and are maintaining their well-earned reputation for the best inclosed arc lamps and arc lamps for constant potential circuits in general.

Thomas J. Fay.

Bergmann Improved Enclosed Arc Lamp.

THOMAS J. FAY AND ASSOCIATES.

Thos. J. Fay, for a number of years in the employ of The C. & C. Electric Company and late general manager of that concern, has resigned his position and opened an office in the Central Building, 143 Liberty street, New York, with a view to taking up engineering work. Mr. Fay is also a New York representative of The Crocker-Wheeler Electric Company and holds the exclusive agency for Crocker-Wheeler dynamos, motors and appliances, for Mexico, Central America, South America and the West Indies.

Mr. Fay has associated with him some of the best talent in the electrical field and proposes to operate on a large scale, and with this end in view is completing an organization which will be best suited to the handling of large contracts. The firm will be known as Thomas J. Fay and Associates, Electrical Engineers and Contractors, and are specialists in the application of electric motors in all cases where economy and durability are essential features.

Attention is given to the direct attachment of motors to printing presses, pumps, ventilating wheels, metal-working tools, and, in short, to every class of machinery in which it is desired to economize in space, power and depreciation. These gentlemen are now working on several undertakings of some moment, among which is a transmission system of fourteen miles, of 600 horse-power.

Our long acquaintance with the principles of this firm would lead us to believe that parties desiring the services of consulting engineers in the matter of electrical work of any kind, will find it very advantageous to call on Mr. Fay; in short, his connection with the Crocker-Wheeler Company reflects the ability of the gentleman in question to the utmost extent. Intending purchasers in the countries south of us will find in this firm a reliable house to correspond with on the subject of electricity for electric lighting and the transmission of power, and it is believed that money can be saved by purchasing complete plants, including the motive power, through this house.

Mortimer Norden, of the firm of Miner and Co., has made application for a receiver to be appointed, and to dissolve the partnership previously existing between Edward D. Miner, Edwin F. Gavin and Mortimer Norden.

VULCAN TORCH.

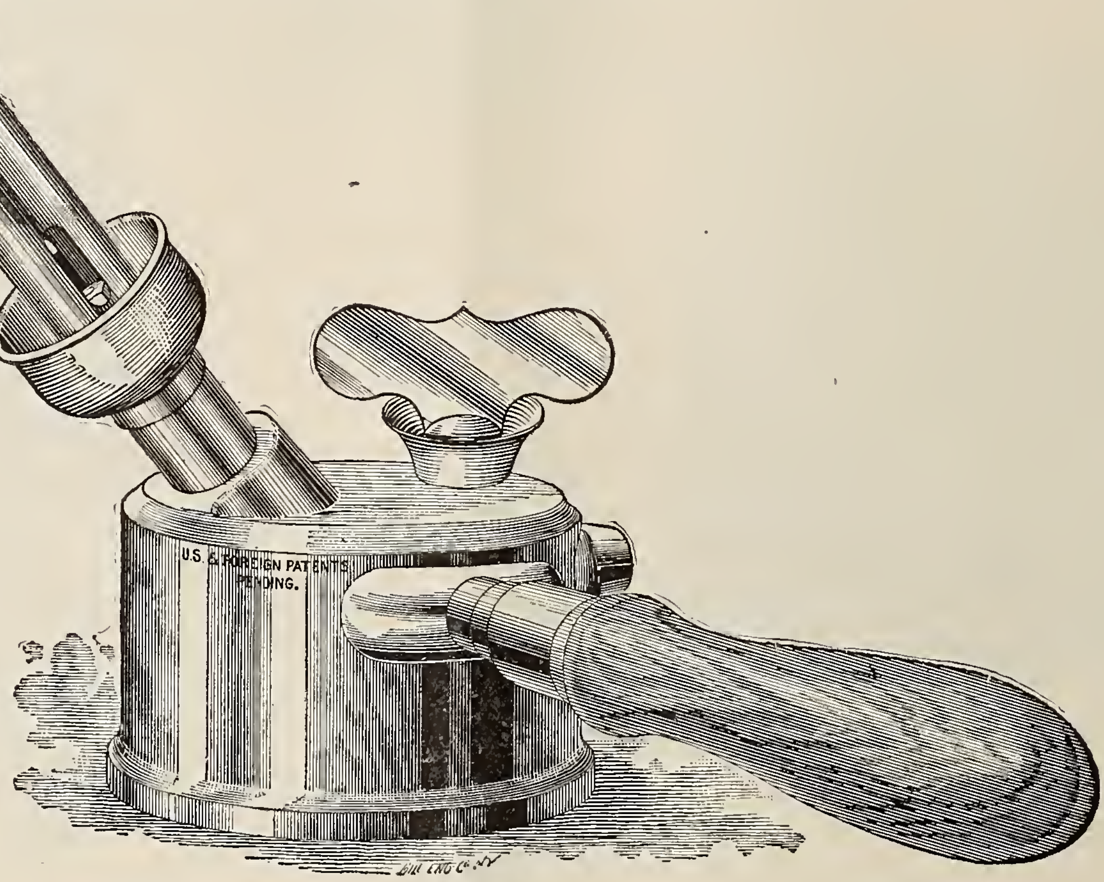
The Vulcan Company, manufacturers of high-grade gasoline appliances, 315 Madison avenue, corner 42d street, New York, manufacture the high-grade gasoline vulcan torch. This torch, as shown in the illustration, is one of the most convenient torches for electric wiremen, for installing wires in conduits and general electrical work. It is made of solid material. The handle can be placed on the side, as shown in illustration, or on the back, giving two positions, due to which this torch has become so popular. The two positions for handling this torch make it very convenient for the various duties required of it. November 21 last the Vulcan Co. sent out the following notice to their customers and the trade:

"We have this day reduced the price of the vulcan torch from $32.00 per dozen, which is the lowest it has ever been sold at, to $24.00 per dozen, cash 30 days; 5 per cent. off, cash ten days; single torch, $2.50 each, net. A ten per cent. discount made to jobbers on large quantities, making it absolutely the cheapest and best torch in the market, having given satisfaction to all who have used it.

"This torch burns naphtha or gasoline, and at a cost of one cent generates over 2,000 degrees of heat and maintains a steady blast for one hour or more.

"It is also absolutely safe, most simple, and can be taken apart and carried in the pocket. Is used by all metal trades and has no equal for burning off paint."

Since this circular has been issued the sales have increased over 100 per cent.



Vulcan Torch.

CABLE MUST GO.

We note in the New York Press that it has been decided by the Metropolitan Traction Company to change the motive power of the Broadway road. The cable has not proved satisfactory. It has not been as safe nor as speedy as it was hoped it would be, and so on Wednesday next bids will be entertained from companies which are the promoters of compressed air and of other motive powers.

These bids were invited several weeks ago, but so closely was the secret kept that it was not until last night any one save the directors of the Broadway road and the managers of the companies intending to bid had any notion of the contemplated change.

The cable bed, of course, will be retained, but the cost of the introduction of the new power, it is estimated, will be in the neighborhood of $4,000,000.

Thus it has come to pass that William C. Whitney in this, as in many other commercial enterprises, has had his ideas triumph. He was opposed at all times to the cable, arguing against it not merely because of its cost, but because of the difficulties attending its being kept in order and of the impossibility to regulate it to meet emergencies or conform to the exact demands of traffic.

In addition to this, the cable was rather ancient in conception to suit the advanced notions of Mr. Whitney, and was too little susceptible to improvement which did not contemplate a practically new plant.

He was not prepared, however, to make a strenuous contest against it at the time of its adoption, and in consequence John D. Crimmins, who led the cable party, temporarily triumphed.

Mr. Whitney bided his time, but not idly. He was permitting the inventive genius in practical propulsion to furnish him with argument, simply assuring himself that the directors and large stockholders constantly, though not oppressively, were kept informed of them.

It was the old story of the drop of water falling upon the stone. These men began inquiring from Mr. Whitney if he had noticed the improvements in the science of mechanics, and began venturing the proposition that perhaps after all the cable might be improved on.

Of course, Mr. Whitney had had no time to give to these subjects. He remarked that he had given the subject only the most desultory thought since the company had adopted the cable, considering that that was final. He on the surface was the man least concerned of all. But it happened nevertheless that Mr. Whitney, to the amazement of Mr. Crimmins, carried with a decisive majority the proposition upon which he had been defeated only a few years before.

Mr. Crimmins, it is well understood, does not relish the situation, but is too politic to do anything other than contribute his best judgment as to the motive power and the plan for it which the company finally will determine upon. Mr. Crimmins as well appreciates the pace at which the world moves and will interpose no further objection. The only possible hitch that can now come in

the plans may arise from the terms which the companies invited may submit.

That, however, is conceded to be mere detail. The company has asked for a better motive power than the cable, and undoubtedly will get it.

POSSIBLE CONTRACTS.

Manchester, N. H.—An electric road is proposed between Berlin and Graham.

Brunswick, Ga.—An electric light plant will be installed in the Oglethorpe Hotel by M. S. Gibson.

Greenup, Ky.—The Wilson Brothers have received a franchise for lighting the city by electricity.

St. Louis, Mo.—The Western Electric Co., of Chicago, and the St. Louis Electric Light & Power Co., have consolidated, the capital stock being placed at $700,000. A big duplicate plant will be built at once. D. & W. Guernsey, general manager.

St. Louis, Mo.—A proposition for the erection of an electric light and power plant has been submitted by Fred Fritz, 1824 South Seventh street.

Lenoir, N. C.—The Board of Trade will endeavor to secure the construction of an electric light plant, waterworks and other municipal improvements. S. T. Pender, secretary.

Weldon, N. C.—The Roanoke Navigation and Water-Power Co. contemplates putting in electrical machinery on its canal, near Weldon, for the purpose of supplying light, heat and power.

Weldon, N. C.—The Mahone Canal Co. has received a franchise for furnishing electric lights.

Chattanooga, Tenn. — The Western Union Telegraph Co. will rebuild its line to Birmingham, to cost about $15,000.

Mobile, Ala.—Plans have been prepared for a Y. M. C. A. building, by Watkins and Johnson; to include electric fixtures, elevators, steam heating plant, etc. Cost, $40,000.

NEW CORPORATIONS.

Binghamton, N. Y. — The Star Electric Co. has been incorporated by G. S. Beach, C. E. Beach, S. H. Chaut, and H. R. Doughty. Capital stock, $100,000.

Jacksonville, Fla.—Commercial Electric Light and Power Co. has been incorporated with a capital stock of $25,000. Incorporators, A. T. Parker, H. C. Bullard, A. G. Hamlin, R. Z. Boyd, J. H. Norton, and C. S. Hammatt.

Pine Bluff, Ark.—The Pine Bluff Power and Transit Co. has been incorporated by J. B. Trulock, D. C. Bell and others. Capital stock, $100,000.

St. Louis, Mo.—O. M. Sullivan, C. W. Fitch and J. H. Maxwell have incorporated the Imperial Electric Light and Power Co. Capital stock, $2,000.

NEW TELEPHONE COMPANIES.

Nashville, Tenn.—The Wautaga Telephone Company has been incorporated W. by Callen, J. M. Lacey, W. F. Scott, W. P. Dungan and E. E. Hunter, to erect and operate a telephone system and line from Bristol to Mountain City, Tenn. The main office of the company will be at Elizabethton.

Albany, N. Y.—The Belmont Telephone Company has been incorporated to maintain a telephone line in Belmont and other points in Allegany county. Capital, $2,500, and directors J. H. Anderson, W. J. Richardson, W. K. Paul, W. P. Clark, Henrietta W. Paul, Mary E. Anderson and Helen A. Richardson, of Belmont.

Gadsden, Ala.—A company is being organized to construct a telephone line to Centre.

Beaumont, Tex.—The East Texas Telephone Company has been incorporated by C. A. Epping, T. E. Spottswood, R. E. Lundy and C. E. Jones, with a capital stock of $5,000, to establish telephone systems, etc.

Parkersburg, W. Va.—The West Virginia Telephone, Telegraph and Transportation Company has received a charter. Capital stock, $200,000. Incorporators, J. W. Wolfe, A. F. Denniston, W. H. F. Kelley and others; to construct a telephone line, etc.

Jefferson City, Mo.—Ellis Wainwright, Adolphus Busch and others, of St. Lonis, have incorporated the Kinloch Telephone Co. Capital, $1,500,000; to construct telephones.

Gainesville, Tex.—The Southern Telephone Co. has bought the plant of the National Telephone Co. in Gainesville, and will rebuild the snme.

Richmond, Va.—A franchise for the construction of a long-distance telephone system has been applied for by the American Telephone and Telegraph Co. Address, care of Col. George W. Anderson.

Biloxi, Miss.—The People's Telephone Exchange has been incorporated with John Walker president, and J. C. Carraway, secretary.

N. Y. City.—At a meeting of the Board of Directors of the Westinghouse Electric and Manufacturing Company a quarterly dividend of 1¾ per cent. upon the preferred stock was declared. Several important changes in the organization of the company were made. The offices of general manager and assistant general manager were abolished and Lemuel Bannister was appointed first vice-president in charge of the Commercial; H. B. Warren, second vice-president in charge of the manufacturing, and P. F. Kobbe, third vice-president in charge of the financial department.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued November 3, 1896.

570,454. Galvanometer. C. Coleman, Chicago, Ill. Filed June 9, 1896.

570,475. Trolley. J. H. Hance, St. Louis, Mo. Filed February 26, 1896.

570,481. Instrument for Measuring Electric Currents. R. M. Hunter, Philadelphia, Pa. Filed October 4, 1892.

570,496. Magnetic Separator for Threshing Machines. E. H. Osborn, Des Moines, Ia. Filed Jan. 24, 1896.

570,508. Electric Alarm Bell. R. Segerdahl, Chicago, Ill. Filed June 27, 1892.

570,517. Incandescent Lamp and Socket. A. Swan, New York, N. Y. Filed January 23, 1896.

570,565. Electric Railway. H. C. Reagan, Jr., Philadelphia, Pa. Filed March 11, 1896.

570,566. Magnetic Path for Underground Railways. H. C. Reagan, Jr., Philadelphia, Pa. Filed April 21, 1896.

570,599. Return Circuit for Electric Railways. G. Kapp, Berlin, Germany. Filed December 31, 1895.

570,616. Burglar Alarm. F. Steinkoenig, Sioux City, Ia. Filed June 12, 1896.

570,619. Process of Manufacturing Plates for Secondary Batteries. C. H. Weise, Possneck, Germany. Filed April 4, 1895.

570,663. Method of and Apparatus for Regulating Dynamo Electric Generators or Motors. J. W. Easton, Brooklyn, N. Y. Filed April 1, 1892.

570,700. Track Instrument. T. B. Dixon, Henderson, Ky. Filed September 12, 1895.

570,740. Trolley. F. T. Walton, Portland, Me. Filed May 23, 1896.

570,773. Telephone Switch. C. N. Sandbeck, Harmony, Minn. Filed April 8, 1896.

570,808. Safety Switch. E. Jokl and W. M. Christian, Vienna, Austria-Hungary. Filed August 14, 1896.

570,823. Electric Arc Lamp. H. A. Seymour, Washington, D. C. Filed July 1, 1896.

570,824. Electric Arc Lamp. H. A. Seymour, Washington, D. C. Filed July 7, 1896.

570,825. Carbon for Arc Lamps. D. A. Shesler, Toledo, O. Filed February 13, 1896.

570,827. Electrically Controlled Elevator. S. D. Strohm, Philadelphia, Pa. Filed April 4, 1896.

570,839. Towing Apparatus. A. de Bovet, Paris, France. Filed April 5, 1894.

570,840. Automatic Telephone System. M. Brooks, Minneapolis, Minn. Filed January 26, 1895.

570,845. Substance for Telephone Electrodes. D. Drawbaugh, Eberly's Mill, Pa. Filed January 10, 1896.

570,852. Type Printing Telegraphic Apparatus. F. H. W. Higgins, London, England. Filed October 11, 1895.

570,878. Multiple-Series Controller. J. F. McElroy, Albany, N. Y. Filed August 28, 1894.

570,882. Automatic-Safety Device for Electric Circuits. L. G. Rowand, Camden, N. J. Filed September 13, 1895.

ELECTRIC STOCK QUOTATIONS

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	19
Edison Elec. Illg. Co., New York,	100½	101½
Edison Elec. Illg. Co., Brooklyn,	99	101
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	1	2
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	30½	31½
General Electric Company pf.,	70	75
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	146	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	115
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	—	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	51½
Westinghouse El. & Mfg. Co., assd.,	26	28

*Ex dividend.

The Electrical Age.

VOL. XVIII., No. 26. NEW YORK, DECEMBER 26, 1896. WHOLE No. 452

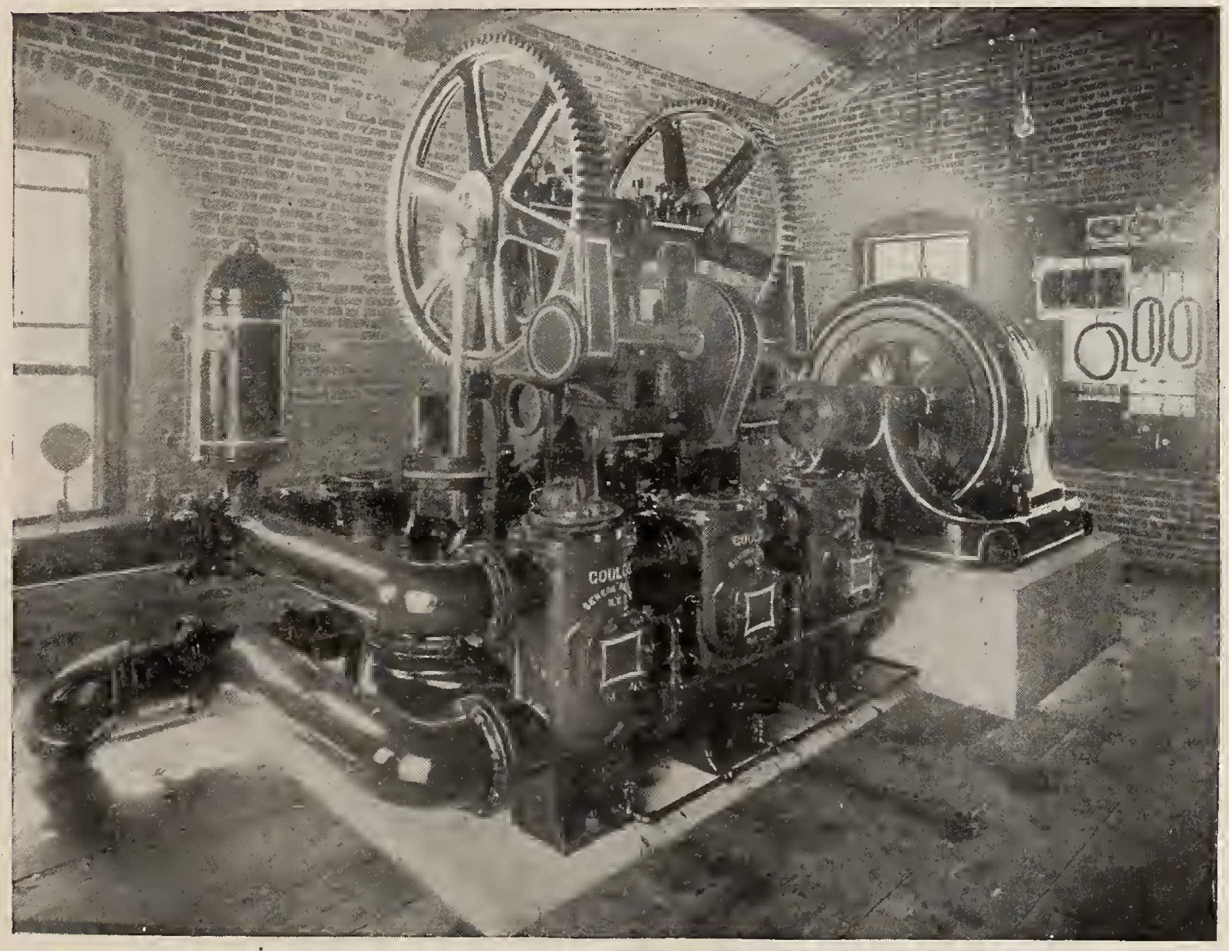


Fig. 2.—Gould Pump and 75-H. P. Induction Motor at Warehouse.

THREE-PHASE POWER TRANSMISSION PLANT.

An interesting though small three-phase power transmission plant has been installed at Itasca, Wis., just east of Superior, the division headquarters of the Chicago, St. Paul, Minneapolis and Omaha Railroad Co. At this point the shops, round-houses and store-rooms of the railroad are located, and in their operation the company utilizes power for an average of twelve hours per day and steam the entire twenty-four. About a mile and a quarter away from Itasca extensive docks have recently been built and on them has been constructed a warehouse 1,500 feet long and 300 feet wide. Boats are loaded and unloaded on one side of the dock, tracks are laid the entire length of the opposite side, and the cars load and unload their freight at any point in the warehouse.

The protection of the warehouse from fire, containing, as it does, many thousand dollars' worth of property, was one of the first considerations after the construction of the building, and naturally the first idea was the purchase of a steam plant and pump. About this time the attention of the railway company was called to the numerous power transmission plants which the General Electric Co. had installed, and they were not loath to take advantage of the merits of the three-phase system of transmission. Electricity carried the day, and at the present moment a 750-gallon pump is operating and incandescent and arc lamps are scattered over the warehouse and dock, the shops, roundhouse and other buildings at Itasca all operated by current from the power plant.

The electric current is generated from a G. E. 100-kilowatt three-phase generator, at a voltage of 2,000 volts, this voltage having been adopted in order to do away with the necessity of step-up transformers. The engine is driven at a speed of 900 revolutions per minute by a Ball & Wood engine of 110 H. P. At the dock the pumping plant is installed. This consists of a 75-G. E. 2,000-volt induction motor, coupled to a Gould double-acting pump having an output of 750 gallons per minute, operating at 80 pounds pressure and competent to throw four effective fire streams upon the docks and into the warehouse.

Mr. H. C. Hope, the superintendent of telegraphs and signals for the railroad campany, states that the plant is one of the most perfect working light and power plants he has ever seen. All kinds of tests have been made with it and the results have been satisfactory.

The dock warehouse is 1,500 feet long, and the inside is provided with five fire station, fitted with electric fire-alarm apparatus for transmitting signals between the docks and the engine house; also switches connecting the motor and the pump to the power wires. Hydrants and reels are suspended from the walls, each reel having 100 feet of hose, so that, after the fire signal has been given from the engine house, one man can carry hose and water to the fire in from ten to thirty seconds. A fire corps has been organized and the men are drilled three times each week.

The economy of this plant is markedly appreciated by the railway company. It has enabled them to save the expense of an engine and pumping plant at the dock, which means boilers, engines and all the various expensive accoutrements of such a plant and the maintenance of an engineer and an assistant, besides effecting consider-

able economy in the operating expenses. In addition to current furnished the pump the generator also supplies electricity to twelve alternating-current arc lamps, six on each side of the dock, supported on brackets from the sides

Warehouse and Dock.

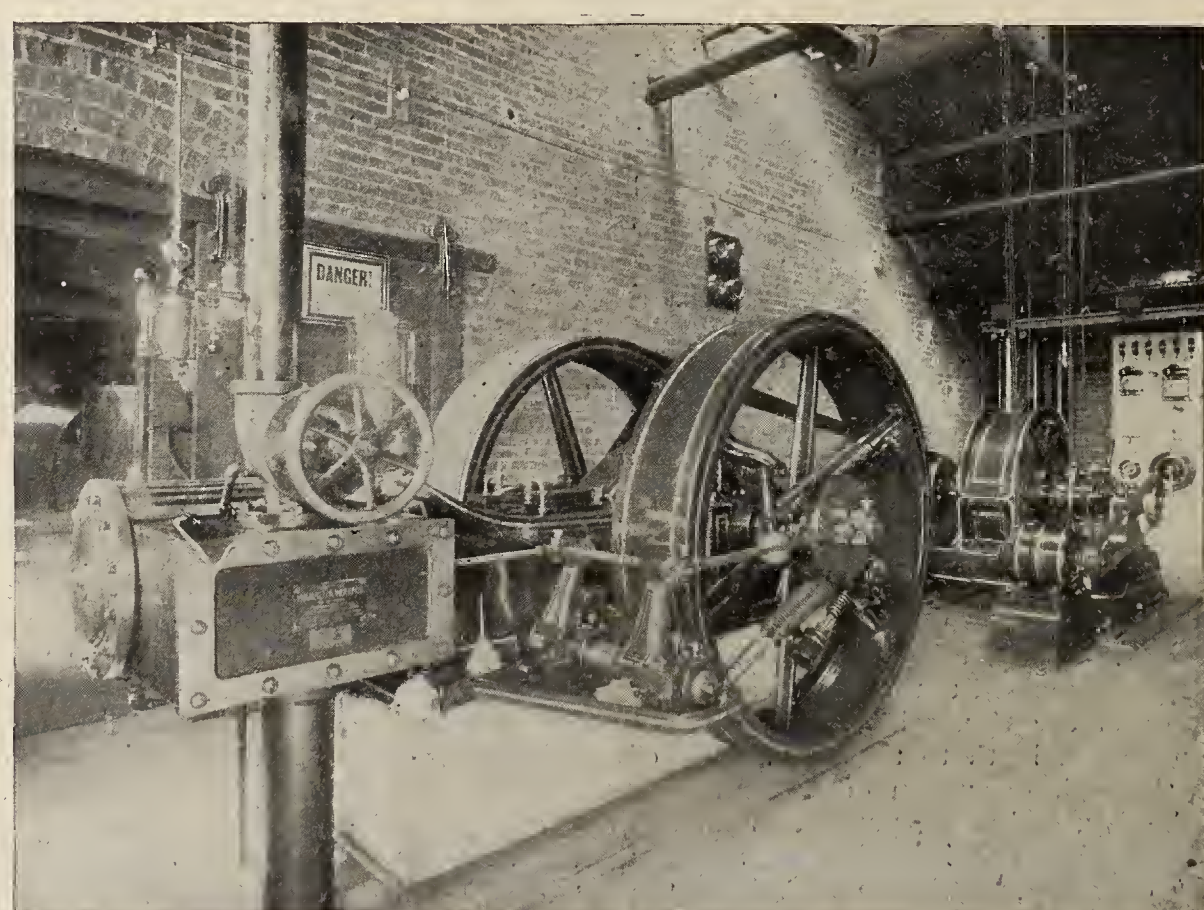
of the building. Over 200 16-C. P. lamps are required to light the warehouse, and in Itasca itself about 150 more 16-C. P. incandescent lamps are also installed.

This plant is a show plant in that district and no railroad man who visits Itasca is allowed to depart before he has been shown the pumping plant. The insurance companies have also expressed considerable satisfaction at the adoption of electricity in lieu of steam.

Chesterfield, S. C.—The Chesterfield Telephone and Telegraph Co., has been incorporated with J. A. Welsh, president; G. J. Redfearn, secretary and treasurer.

Bristol, Tenn.—The Consumers' Electric Light Co. has been incorporated by Albert Partlett and others.

Bowie, Tex.—The Bowie Light Co. has been incorporated with a capital stock of $15,000, by T. C. Phillips, A. E. Thomas and J. N. Graves, to operate an electric light plant, etc.



Three-Phase Generating Station at Itasca.

Fayetteville, Ark.—The Fayetteville Electric Railroad Co. will build a water-power plant for furnishing power for its railway. Address John A. Griffin, president.

RUBBER AS A CONDUCTOR.

(Continued from Page 743.)

"After the hard rubber has fully cooled it is removed from the press and placed on a metal case coated with wax or paraffin, a strip of this wax being run around the hard rubber mould to cause it to be temporarily held to the wax case. Then, by preference, I make one or more, preferably four, connections just outside of the hard rubber mould by scraping off portions of the wax to expose the metal backing of the case. When this is done, I make a hasty compound of black lead or graphite and alcohol, and I coat the wax case and the outer face of the hard rubber mould with the same, using for this purpose a fine brush, by means of which the paste is evenly distributed over the face of the said case and mould, the alcohol soon evaporating.

"The brushing of the black lead upon the surface of the hard rubber mould and wax case, and the subsequent removal of any remaining particles of the lead, or the polishing of the face in a black lead machine, will result in the face of the hard rubber mould and wax case being completely metallized, so that they will serve to take a deposit of metal as nickel.

"The rubber mould and wax case are then washed with

a solution composed of one ounce of phosphorus to one quart of pure alcohol, which solution is then washed off with water. When this has been done they are suspended in a vat containing the well-known nickel solution, by means of one or more hooks on one edge of the case, engaging a rod or other means, constituting the negative pole or battery, the connection with this pole being

The Power House.

through the metallic backing of the case. When the case with the hard rubber mould adhering to it is suspended in the vat, the current of electricity is turned on, and the nickel anode, which is located in the vat opposite the metallized face of the hard rubber mould is dissolved and the metallic nickel is deposited in a thin film upon the whole of such surface and of the wax case, the deposit

The Dynamo Room.

commencing first at the points where the electrical connection is made, namely, where the wax has been removed to expose the metal backing of the case, and then gradually creeping over the entire metallized face of the hard rubber mould, the current returning through the metal backing of the case and the suspending hooks.

"When a sufficient amount, or shell, of nickel has been de-

Bird's Eye View of St. Elizabeth's, Government Insane Asylum, Washington, D. C.

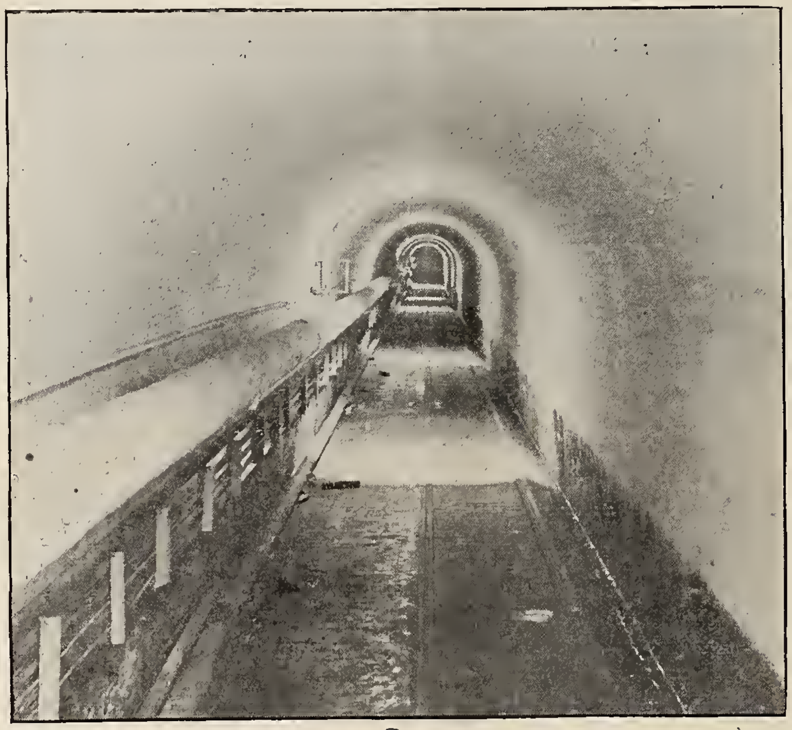
posited upon the hard rubber mould, the mould is removed from the nickel vat and placed in a copper vat, and the shell is then completed with copper in the usual manner, producing a shell of nickel, with copper backing, to give it stiffness. When the shell has been removed it will be found that all the fine lines, dots and other marks or impressions will be found exactly reproduced in nickel, and with all the sharpness that is characteristic of the original; at the same time the nickel is much harder and more durable than the copper and many other metals which have been used for deposit upon other substances."

"Mr. Smith is a firm believer in his discovery, and of its ultimate adoption by all electrotype foundries. For the gramophone and phonograph he declares it cannot be excelled, and that when used the sounds reproduced will have the clear metallic sound that is now lacking.

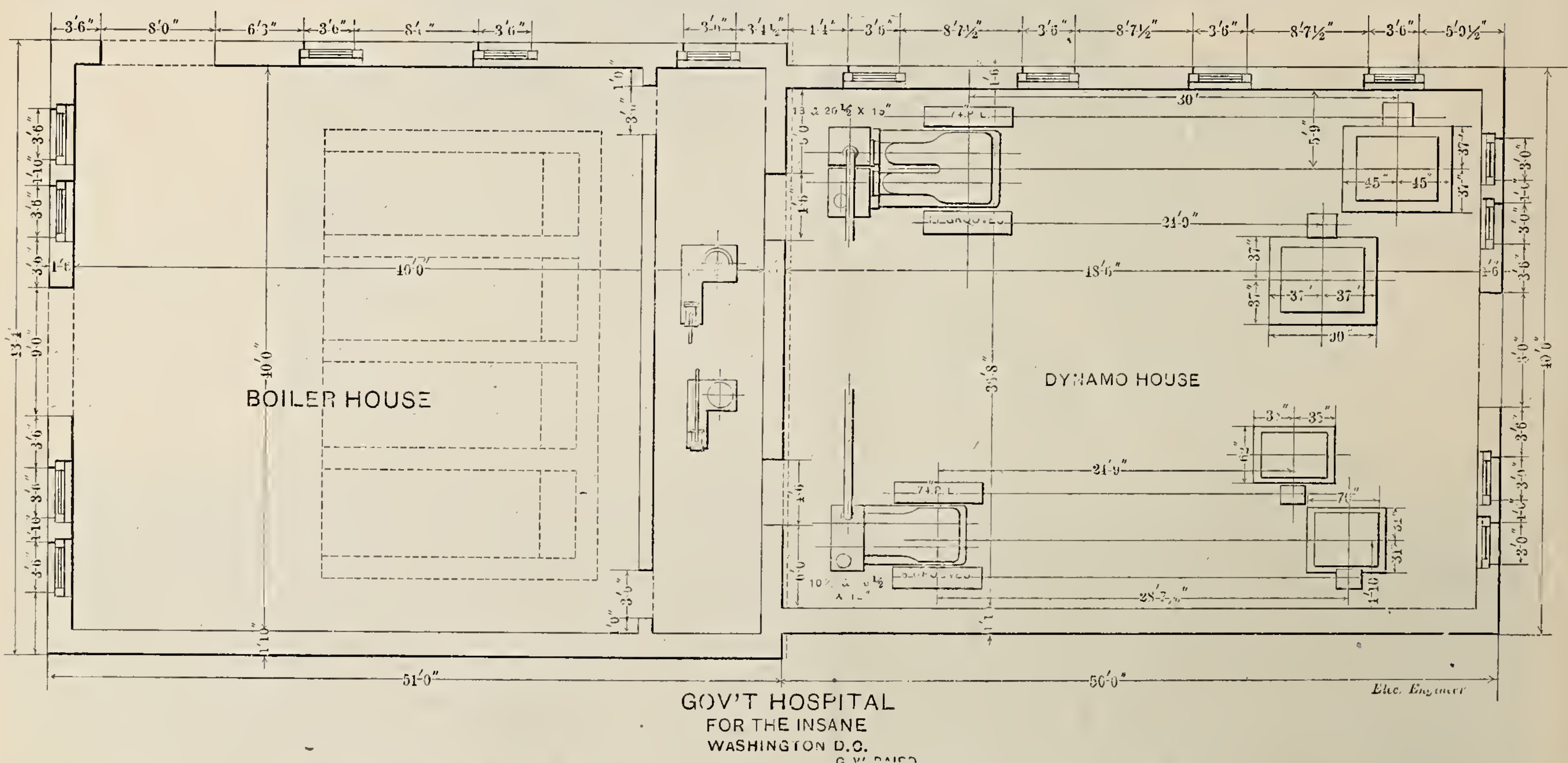
ELECTRIC LIGHTING IN AN INSANE ASYLUM.

The steady and progressive growth of electric light plants in this country has been going on in a noticeable manner, especially in connection with state and municipal buildings. The St. Elizabeth's U. S. Hospital for the Insane, Washington, D. C., has recently been equipped with an electric light plant and wired to meet its requirements in a manner thoroughly in line with the best of practice. The hospital spoken of was established March 3, 1855, by an act of congress. It is a most notable institution, in which this melancholy disease is treated with the utmost system and patience. The hospital is managed by a board of citizens of the District of Columbia who are honored by appointment from the chief executive. Dr. W. W. Godding is the resident superintendent. He, with

the aid of the proper assistants, takes care of about 2,300 inmates. The buildings are divided into six groups. 400 male inmates contained in nineteen wards, 375 female inmates in twenty wards, 120 inmates in the criminal and homicidal wards, and several other departments which might be more interesting in the columns of a medical journal than here. Some of the inmates are sufficiently sane to be trusted in the occupation of farming and other agricultural pursuits. The buildings connect by underground tunnels, and are otherwise joined through the medium of telephone lines. The pharmacy contains the central office, the circuits being carried from there to the roof in Kerite cables and thence to different parts of the buildings in the regular manner on poles. Kennedy & Du Perow supplied the material, which was installed by J. U. Burket, of Washington, D. C. The telephone plant embraces the outhouses, including the stables, dynamo room and pump room. In 1895 contracts were awarded for a complete electric light plant, including engines, dynamos, boilers and wiring. In the installation of this apparatus many of the patients took part. The former manager of the Potomac Light and Power Co., Mr. Michael J. O'Donnell, was appointed engineer of the plant. The work has been completed to the extent of 6,000 lights and is ready for immediate operation. The E. Keeler Co., of Williamsport, Pa., installed two horizontal tubular boilers to furnish 400 H. P. and tested up to 150 pounds pressure. Rope transmission is employed for driving the dynamos. The engines, Armington & Sims type, are two in number, with two cylinders, opposite cranks and automatic cut-off of the horizontal condensing type, high speed. They are cross-compound engines, the cylinders of one being thirteen and twenty and a half inches in diameter, with fifteen-inch stroke, giving 200 H. P. at 265 revolutions per minute. The smaller engine has cylinders ten and a half and sixteen and a half inches in diameter. It has a twelve-inch stroke and will give 100 indicated H.P. at 285 revolutions per minute. Two rope wheels, with eleven grooves to carry a three-quarter-inch rope, are used in connection with the larger engine, the smaller engine having rope wheels carrying six ropes each. General Electric multipolar dynamos are used, compound wound and self-regulating. There is a larger and a smaller pair. The former of 100 K.-W. and the latter 50 K.-W., at 125 volts apiece. The wiring presented certain difficulties because of the

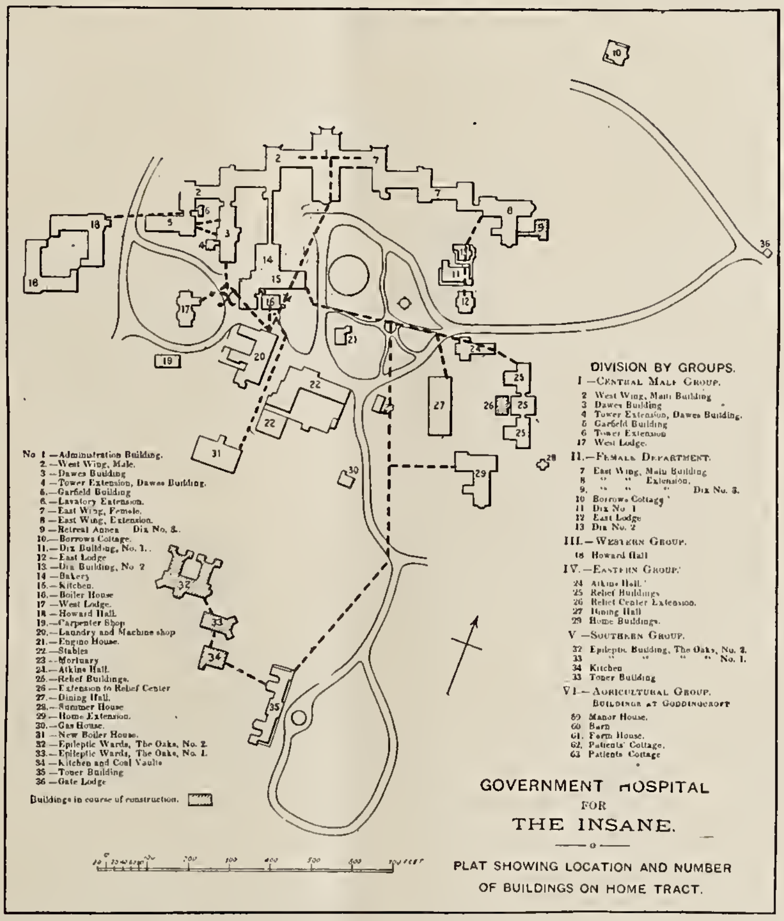


Tunnel Connecting Buildings of Government Insane Asylum, Washington, D. C.



Plan of Engine and Boiler House, Government Insane Asylum, Washington, D. C.

fact that accidents must be entirely out of the question with 2,000 lunatics around. Apparently money was not spared to install a system without blemish. 221,000 feet of Kerite wire were used in following out the three-wire system. The apparatus is all beyond the reach of the inmates and the chances of fire in this installation are of the least imaginable order. The illustrations give a bird's-eye view of the asylum, the power house and the interior of the dynamo room; likewise of the huge connecting tunnel between the buildings. In the power house the slate switchboard carries complete sets of ammeters, voltmeters and cut-outs for the dynamos, eleven No. 0000 bare copper wires acting as feeders. There are two No. 8 extra wires used for telephonic purposes, and three No. 6 pressure wires. The telephone wires are carried on poles a distance of 2,700 feet to the main building. From here the cables pass through the tunnel into the subsidiary tunnels leading to each group of buildings. Lead-covered cable was installed in the main tunnel. The Kerite cable used comprises more than 12,700 feet; the largest size exceeding 860,000 circular mils. Iron brackets carry the lead-covered cables in the tunnel. The General Electric cut-outs for the three-wire system allowing branches to be tapped. The cable is absolutely without any taps; all lamps used within the tunnel feed directly from the cut-outs. 30,000 feet of cap moulding was used in the administration building. The difficulties of the work, because of the irresponsible condition of the patients, was never lost sight of during the installation of this plant. Very much circular loom, flexible conduit was used, exceeding 62,000 feet, and porcelain tubes for perfect insulation to the extent of 15,000. The utmost care was taken to make this installation perfect, and the numberless details carried out to bring about this result would necessitate columns of reading matter. The firm of Kennedy & Du Perow supplied the circular loom tubing, wires, cables, cut outs, chandeliers and smaller sized switchboard. Their efforts have been in perfect harmony with the system employed, that is, of working unremittingly. We hear that about $6,000.00 worth of ventilators and electric fans are to be employed, and electric heating devices and arc lamps *ad libitum*. The richness of this installation is such that it would require separate treatment to be given each department of the work in order that it may receive its proper description. This asylum being practically a hospital, is naturally equipped with the latest electrical appliances for medical use, such as electro-therapeutic and X-ray machines. These require special electrical accessories. The advantage of power on the premises will be deeply appreciated by the physicians in charge.



The Government Insane Asylum at Washington, D. C—Tunnel Connecting Buildings Shown in Dotted Lines.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTICAL ENERGY.

(Continued from Page 746.)

IF ANY transforming device is employed to feed a distant section of the line, it must be remembered that the capacity of the device must be great enough to look out for the maximum demand on this section. Suppose now that we wish to feed some suburban line where the load has considerable momentary fluctuations but where the traffic is moderately constant during the year. In this case the booster could be used with a storage battery at the end of its feeder, the battery supplying the line. The advantages of this combination are greater than with the simple booster, and in many cases they will compensate for the interest and depreciation on the battery and the loss in it. If the arrangement is properly made, the load on the booster and line wire will be practically constant, thus decreasing the capacity of the booster to that required for the average load, while less copper will be required for a given loss. As to the latter point, suppose a given amount of power is to be distributed in twenty-four hours, say 200 amperes at 600 volts, if the load is uniform, the loss will be proportional to $200^2 \times 24$ hours. If it is all distributed in twelve hours, the loss will be proportional to $400^2 \times 12$ hours, or twice as much. So in the case of the steady load the same power could be transmitted with the same loss with half the copper. It makes no difference whether the variation extends over twelve hours in twenty-four or it occurs every other minute, the result will be the same. It is apparent then that it is of the utmost importance to keep the line steadily loaded, as well as the station, and this points to the location of the battery near the points of consumption and not in the station. By this system —a booster with storage batteries—it is possible, assuming the same loss, to transmit power to a distance of ten

miles with approximately the same amount of copper that would be required for a five-mile transmission on the direct system. It would increase the economical radius of distribution twice and the area of distribution four times. A single station could economically supply lines within distances up to ten or twelve miles. If it is desired to still further increase the radius of distribution, it is possible to do this by employing some of the alternating current methods that have come into use. I will discuss these methods later, but at this point I may remark that the use of stationary and rotary transformers permits the energy to be transmitted in the form of alternating currents, and to be changed again into continuous currents of any required voltage. These rotary transformers, supplied by an alternating current which is transmitted from the station at a high voltage, may be used to feed the line directly or they may be used to supply storage batteries which are connected to the line. In the latter case we have the advantage of decreased size of apparatus, of steady load on the station, and of a minimum cost of copper on the line; which system it would be best to employ would depend upon the distances and the character of the line and load.

Of the systems that I have proposed for city and suburban distribution from a single station, three have been successfully employed, namely: the booster system; the booster system with batteries, and rotary transformers operating directly on the line. When we consider the advantages of a single station and a steady load, it seems evident to me that many of the large traction systems would do well to concentrate their stations into one and to use the booster system with batteries for outlying lines, and if necessary use rotary transformers for lines beyond the limit of ordinary suburban work. As to the possibility of the complete shut down of such a station, we have reached such a point in the construction of machinery, both electric and mechanical, that with a proper reserve, a careful system of duplex steam piping, and with fireproof construction of the station, such a possibility may be disregarded; while the batteries would look out for any momentary interruption on the feeders.

CONTINUOUS CURRENT LOW VOLTAGE DISTRIBUTION.

Some of the most important stations supplying incandescent lamps are operated on the three-wire continuous current system. In the last few years a considerable advance has been made in the sale of power for motors from these stations, and this has increased the revenue and has given better average output. The tendency in this country has been in the direction of using storage batteries in such stations, and abroad practically every continuous current station uses batteries. As in the case of traction systems it has been the custom in large cities to build a number of separate stations instead of building a single plant and distributing from it. The batteries have been placed in the stations themselves, and no attempt has been made to decrease the amount of copper used by employing a number of centres of distribution and giving the main feeders a steady load. The same considerations that apply to stations for traction work will also apply to stations used to supply lights, and the same methods of distribution may be used. It would unquestionably be more economical, in many instances, to use single stations, to transmit power from these stations to centres of distribution where batteries may be located, and to distribute from these centres on a three-wire system. A case in point is the system used at Buda Pesth, where the energy is distributed from the central station to rotary transformers at sub-stations, these rotary transformers feeding batteries, current being distributed from these batteries on a three-wire system. The reports of the operation of this station show that it is both economical and successful, and it might well be copied by some of the companies of this country. The gross receipts of some of the large illuminating companies bear such a large proportion to the company's stock that a comparatively small saving in operation would mean a considerable increase in the dividends, and there is no doubt in my mind that by using one power station, with battery sub-stations for distribution, that the operation expenses can be considerably decreased.

(To be continued.)

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—PEA COAL.

Philadelphia, Dec. 18, 1896.

Editor Electrical Age.

Dear Sir:—Can you tell me whether there is any reason why pea coal should not be as serviceable for fuel in any electric light plant as any other larger sized coal? The boiler supplies an electric light plant with steam for its engines. The coal used at present is a little larger than the expense seems to call for, while pea coal is cheap and would make a great difference in our monthly bills. Kindly let us know at once.

Yours respectfully,
Peter Pendersen.

(A.)—Provided the grate is properly constructed, pea coal is all right. Many electric light companies save money by burning culm, which is considerably finer. You could do the same.

(Q.)—LINE LEAKAGE.

Boston, Dec. 19, 1896.

To the Editor of the Electrical Age.

Dear Sir:—Your Inquiry Column has benefited me so much in the past that I want to have its good services again. Myself and friends put up a telegraph line more than a mile long, some time ago, using trees for poles and putting the insulators on them. In wet weather the line barely works and the insulators appear to be all right. What is the cause of this? Truly yours,
Maurice Lang.

(A.)—Trees are poor supports for insulators because moisture drips down upon the insulators, and twigs and branches continually ground the line. Arrange the insulators away from waving projections and the line will work.

(Q.)—LIGHTNING ARRESTERS.

St. Louis, Dec. 14, 1896.

Editor of Inquiry Column.

Dear Sir:—I would like to receive the following information: How are the lightning arresters fixed up? Why are they sometimes unreliable? Upon what principle do they depend for their reliability? You will greatly oblige me by answering these questions.

Yours respectfully,
William Siever.

(A.)—The lightning arrester is connected to the line and to the earth by a pipe, etc. This may be noted from its construction if critically examined. The vagaries of a flash of lightning are beyond estimate. The lightning chooses an air gap in preference to a metallic circuit; sometimes the conditions make the circuit preferable. The disruptive discharge of static electricity is so sudden that a conductor has enough inertia to oppose its *immediate* flow. The air is more easily penetrated; therefore the air gap leading to the earth is chosen.

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CONTENTS.

EDITORIALS
Another Mile Stone Approaching 763
Electric Flying Ships 763

GENERAL SUBJECTS
Three-Phase Power Transmission Plant 757
Electric Lighting in an Insane Asylum 759
Present Status of the Distribution and Transmission of Electrical Energy 761
Some Account of the Evolution of the Inductor-Alternator 766

MISCELLANEOUS
Rubber as a Conductor 758
Measurement of Resistance 768

INQUIRY COLUMN 762

BOOK REVIEWS 771

ANOTHER MILE STONE APPROACHING.

The people of this city have been interested in a six-day race. They have watched the endless revolutions of hardy bicyclists with unwearied satisfaction, yet they and others, until this earth is but a myth, will forget the race in which they were busy participants. We are a strange people. Christmas marks an era of rejoicing. It awakens this nation to a state of hysterical tenderness and it makes the people forget that each joyous Christmas leads them further onward in the race of life. A spirit of true congeniality seems to prevail in the air during this period. We leave our cold calculations, cold shoulders and other things of a similar nature outside, where they belong, and meet our friends as though they were really made of flesh and blood and not of dollars and cents. We of the electrical fraternity, as many men high in the estimation of our fellow citizens have observed, delight in Christmas holidays. There are many reasons for this. We like a rest; we feel that by turning the currents of our minds in other directions we will acquire that true perfection of spirit, of moral and mental elevation so necessary at this period of the year. Some that have felt the shock of adversity, whose lack of position has made them feel that life is a mockery and a snare, compose themselves at once in preparation for a week of unstinted merriment. The cynic is sad, Christmas week, and the man of daily labor gathers to his heart his precious few, glad to think that he is as rich as ever and as happy. An awakening ripple of business prosperity seems to find its way into every crevice of the business world. There is need for us to rejoice, such as have passed through this last year's struggle unscathed. There is every evidence that the pulse of trade beats healthier than before and that we may all eat our Christmas dinners with the utmost contentment and satisfaction. We wish you all, friends and readers, a Merry Christmas.

ELECTRIC FLYING SHIPS.

There are times, it seems, when an epidemic of invention of a certain kind affects a nation. Suddenly, as though one were waiting for the other—as though, in fact, by preconcerted signal—the patent office becomes bombarded with an array of applications for devices that differ from each other perhaps more in name than in quality. We have not a word to say about the daily papers, whose columns heave with a congested mass of literature relating to this epidemic of invention. It is a pleasure to contemplate, however, the fact that a species of inventive genius exists in the minds of inventors that makes them throw all their efforts and concentrate all their energy into the design of an air-ship. The day is approaching when X rays will be forgotten in the clamor concerning an electric aerial vessel. We speak seriously when we say that the solution of this problem lies within the capacity of the electrical engineer. There are many questions that deal directly with the laws of motion, the art of wing propulsion and the study of aeroplanes. It may be said that the problem of flight is today merely one dependent upon the personal element of courage. Balloons can hardly be called air-ships. They are merely substantial bubbles that rise, trusting blindly in fate for their security. The modern air-ship is being considered by some minds of the utmost worthiness. In the past the Tissandier Brothers, of France, Renard and Krebs, of Germany; in the present Maxim, the great gun-maker; Dr. Lilienthal, martyr to his own experiments, and Prof. Langley, of the Smithsonian Institute, compose an array of names sufficiently illustrious to make this subject one that should meet with our most serious consideration. The application of electricity to an aerial vessel is exceedingly interesting at the present day, because we feel that it is in our power to produce a satisfactory piece of mechanism for free transit through the air. The rotation of an inclined plane, in conjunction with an apparatus of sufficient buoyancy, would seem to give us the elements required for ascension and propulsion. Pound for pound it is hard to choose from the array of means on the market for producing power. The electric motor might possess a lightness beyond belief were an effort made to secure this point, and it is therefore likely that the invention and construction of a successful ship of the air does not depend upon our lack of ability to construct it, but more upon our loss in applying the proper principles to it. We do not hold in our hand as yet the magic thread by whose means we can wend our way through the intricate maze of practice. It seems, however, that the source of our consolation resides in an instinctive belief, giving us a spirit of confidence and assuring us that the ripe hour is near which heralds success.

The Street Railway Special, by Chas. Alden, C. E., is the title of a pamphlet recently received by us. It is the reproduction of an article recently printed in the "Engineering News" of Oct. 29, 1896. It contains the tables for seventy spirals and branch-off easements; likewise a middle ordinate table for chords of ten feet. Also convenient formulæ for laying out on the ground and curving the rails.

W. H. Thayer, N. Y. manager for Western Electric Company, is on his way to Japan. We understand the big telephone subsidies are at his command.

Monticello, Ark.—The Electric Engineering & Supply Co., of Memphis, Tenn., has received the contract for the erection of an electric light plant.

SOME ACCOUNT OF THE EVOLUTION OF THE INDUCTOR ALTERNATOR.

(Continued from Page 745.)

The Kingdon machine, Fig. 21, is a modernized Henley machine. The exciting and induced coils are wound on the alternate polar projections, and the magnetic connections between the inducing and induced cores are alternately reversed by the rotating keepers C. The whole of the iron in the machine appears to be subject to hysteresis loss. Foucault currents are checked in the usual manner by lamination. In this machine, if the induced coils are so wound that they may be worked in parallel, it is possible to reduce the iron losses in proportion to the load by cutting out both inducing and induced coils in the same degree. I hardly think that this advantage is sufficient to countervail, having the hysteresis loss too high to begin with. A few of these machines were put into practical use, but I think not many.

The machine designed by Rankin Kennedy in 1890 is a twinned form of the Mordey, shown in Figures 17 and 18, with the short-circuiting pieces C′ left out. This necessitates the lamination of the whole of the iron and subjects it all to hysteresis loss. The twins are so arranged that the induced electromotive forces in the inducing coils are in opposition, so as to prevent the development of alternating currents in the inducing circuit. The machine has not, I think, been practically introduced and in my judgment it is less fitted for use than its proto-

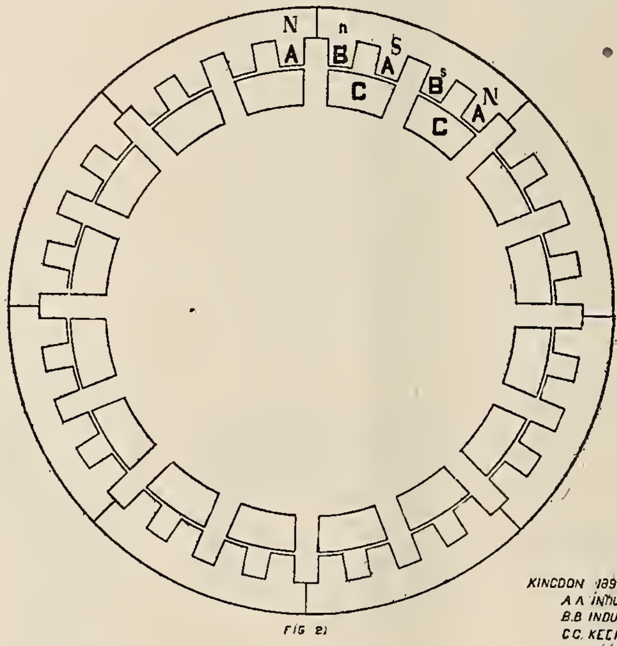


FIG 21

KINGDON 1891
A A INDUCTORS
B.B INDUCED CORES
C.C. KEEPERS.

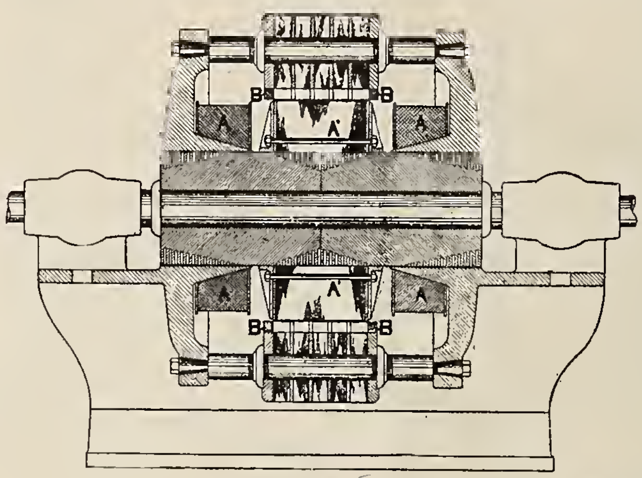


FIG. 22

THOMSON 1890
A′A′ INDUCTOR POLES.
A.A EXCITING COILS
B.B INDUCED COILS.

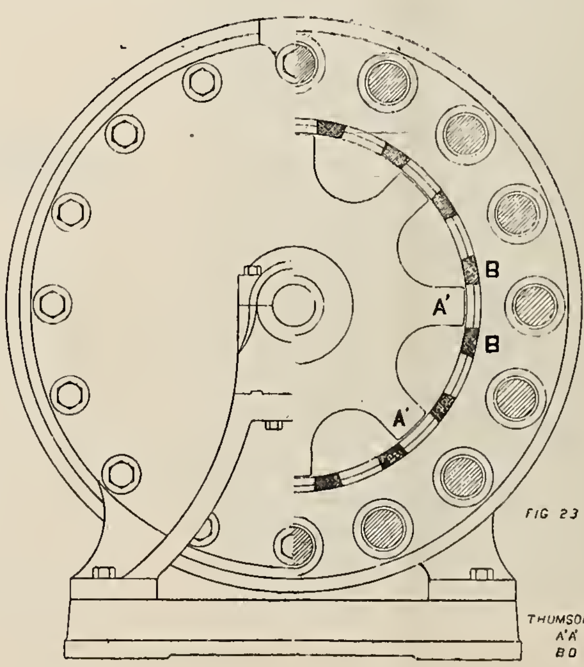


FIG 23

THOMSON 1890.
A′A′ INDUCTOR POLES
B.B INDUCED COILS.

type. The modern machines thus far described lend themselves badly to polyphase working. This is true even of the standard Mordey, while as to the others, adaptation to polyphase means practically duplication or triplication of the whole machine. As polyphase machines, they are merely mechanical combinations of single-phase machines. A machine adapted directly to polyphase working, on the other hand, regulates more closely and is more efficient as a polyphase than as a single-phase machine. The machines that follow are all suitable for polyphase.

The first of them, Figures 22 and 23, is due to one of the masters of our profession in this conntry, and would even on this account alone be worthy of attention. But mechanically, in the robustness and simplicity of design, it seems well in advance of its predecessors. The induced coils are well secured and out of harm's way, and the only moving pieces in the machine are the shaft and the single star-shaped inductor. The adaptation of the machine to single, two or three-phase working is merely a matter of the number and grouping of the induced coils. The duplication of the exciting coil is not, I think, to be considered an improvement. High hopes were entertained of the future of this machine. Of the causes of their frustration it is not for me to speak.

The operation of the Pyke and Harris machine will be clear from the drawings, Figures 24 and 25. The machine consists of a pot magnet with a central core. At the bottom of the pot lies the inducing coil A. The lip of the pot and the core carry inwardly and outwardly projecting laminated polar extensions which support the induced coils B. Between these polar extensions move the rotary laminated keepers C. What I have called keepers here, on account of their appearance and size, really correspond to the inductor in the Thomson machine, and in that which follows, for they normally constitute that portion of the machine in which the flux is most invariable. There is no reason why a machine of this form should not be all right electrically, if well designed. Mechanically, however, it seems to sacrifice that very simplicity which makes inductors desirable.

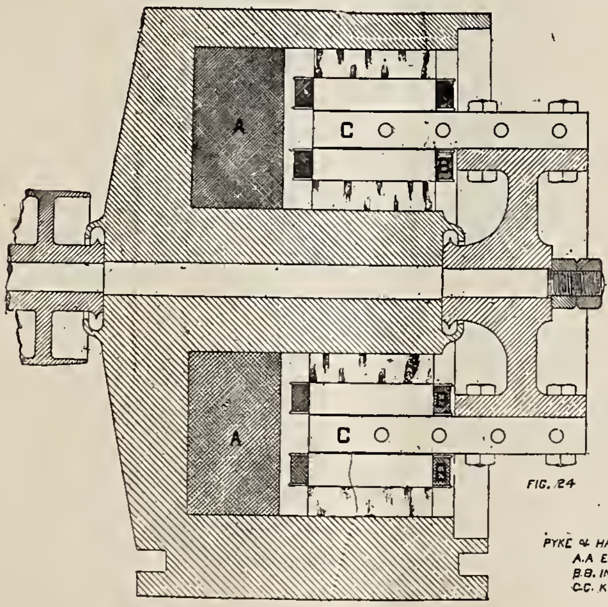


FIG. 24

PYKE & HARRIS, 1892.
A.A EXCITING COILS.
B.B. INDUCED COILS.
C.C. KEEPERS.

I now come to the machine with which I am best acquainted, and in whose designing I took part. For these reasons I may be pardoned for going more into detail in the description, since they enable me to give more information. Coming after that of so many able engineers, it is scarcely to be expected that the work of my colleagues and myself should result in any startling change in form, and, in fact, our improvements are not such as to catch the eye.

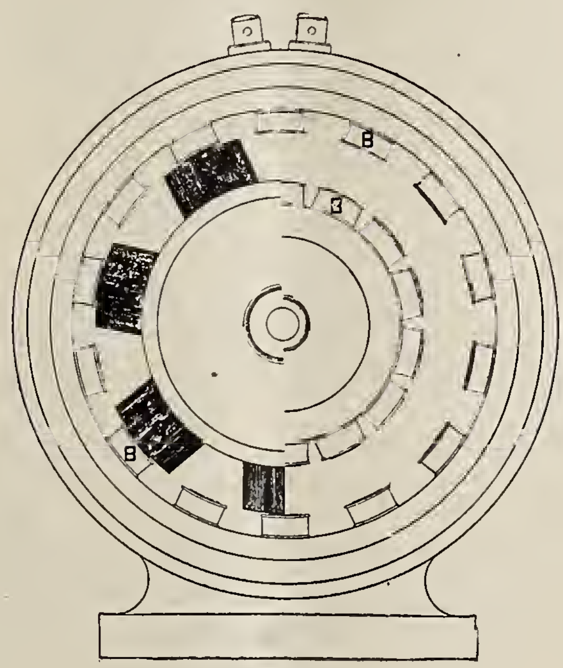


FIG. 25

They, however, have made the induction alternator with iron cored armature a success; so much so, that I have no hesitation in saying that the inductor is not only the alternator of tomorrow, but that it is the alternator of today.

(To be continued.)

Jahl & Ellis will take up the bnsiness of Albert C. Jahl, successor to Frederick Noll, manufacturers' agent for electric light, railway supplies, etc. They are in a position to undertake the largest contracts for supplies of all descriptions. The trade is well acquainted with them. Offices, 39 and 41 Cortlandt st., New York. Telephone, 4719 Cortlandt.

MEASUREMENT OF RESISTANCE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In measuring resistance many methods have come into vogue, each applicable to a certain case and dependent upon circumstances for the results obtained and comparative accuracy.

Classes of Resistances.

Two classes of resistances may be measured, the methods in each case being changed to suit the conditions. They are constituted under the head of

Low resistance tests,
High " "

Use of Ohm's Law.

In any measurement of resistance Ohm's law comes into direct application. The three quantities which completely determine the conditions are the current, electromotive force and resistance.

When two of these are given the third can be determined by simple calculation.

By the rule—

$$\text{ohms} = \frac{110}{.5} = 220$$

Use of Wheatstone Bridge.

For the determination of resistances in general a Wheatstone bridge is employed. A bridge may be constructed for portable use or for stationary purposes, and the galvanometer attached is made as sensitive as the usage it receives will allow.

For portable use the needle is pivoted instead of suspended, and the sensitiveness of the galvanometer correspondingly decreased. When fine tests are to be made, whether of high or low resistance, the needle has a silk suspension and is affected by the slightest changes.

The tests made under such circumstances are less rough and more thoroughly accurate than otherwise.

Method of Substitution.

A simple method of measuring a resistance will be briefly described; it is called the method of *substitution.*

A galvanometer, battery and resistance are connected in series. The E.M.F. of the battery must remain steady and the resistance must be known in ohms. By thus connecting them a deflection occurs on the galvanometer

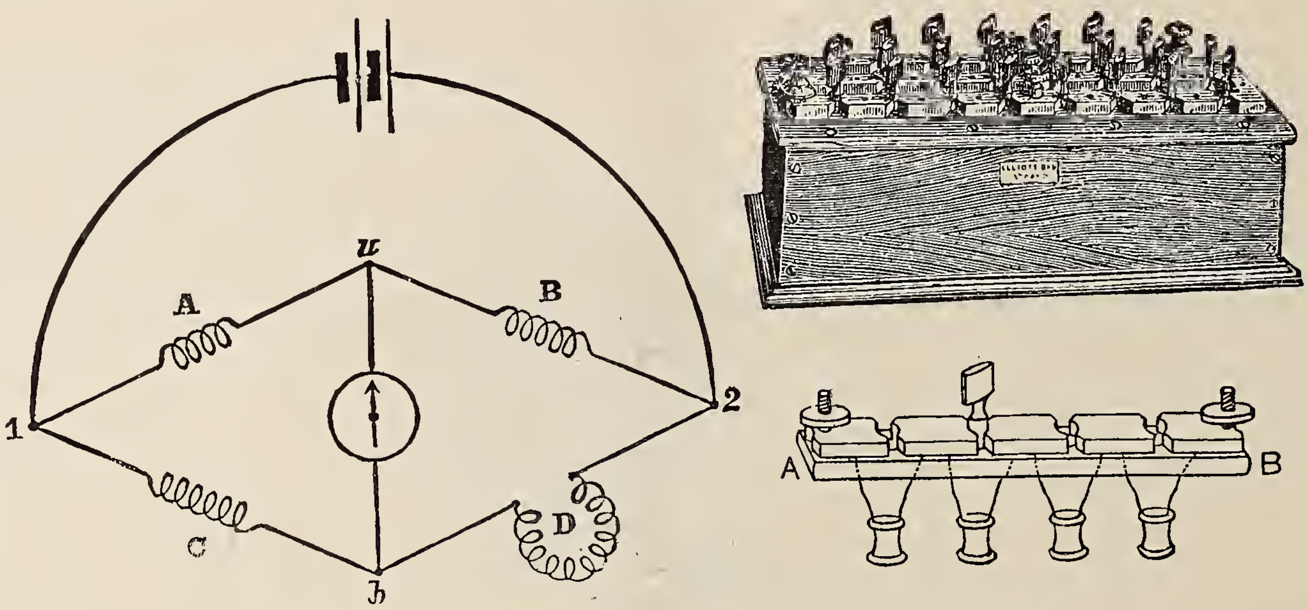


Diagram of Wheatstone Bridge, Resistance Box and Spools.

If, for example, a current of ten amperes be passed through a wire so as to cause a drop of potential or loss of pressure equal to five volts, the resistance of the wire is calculated as follows:

$$\left\{\begin{array}{l}\text{Current} = 10 \text{ amperes,} \\ \text{Pressure} = 5 \text{ volts,} \\ \quad\text{To find ohms.}\end{array}\right\}$$

By Ohm's law, current = volts ÷ ohms,
or resistance = volts ÷ current,
therefore resistance = 5 ÷ 10
= ½ ohm.

Resistance of Incandescent Lamp.

This method is of especial interest when it is desirable to know the resistance of a body while hot. The carbon of an incandescent lamp does not have the same resistance cold as when incandescent; the resistance of carbon continually diminishes with heat.

To find its resistance is not difficult if the above method is applied. Two factors must be known in such a case—the current and the pressure.

A sixteen-candle-power lamp having one-half an ampere and 110 volts applied to it would have the following resistance:

volts = 110
amperes = ½ = .5

which must be carefully observed. Supposing the conditions are as folows:

The resistance = 100 ohms.
The deflection = 50 degrees.

This being noted, the resistance of 100 ohms is removed and the unknown resistances *substituted* therefor.

If the unknown resistance be less, the deflection will be greater, because more current will flow through it. If the unknown resistance be greater than 100 ohms, the deflection of the galvanometer will be less, because less current passes.

Supposing, however, that the second deflection obtained with the unknown resistance equals 25 degrees, the results are tabulated thus:

(1st) Resistance = 100 ohms.
Deflection = 50 degrees.
(2d) Resistance = unknown ohms.
Deflection = 25 degrees.

The rule to be applied is then as follows:

Known resistance : unknown resistance = $25^\circ : 50^\circ$.

Care must be taken to remember which is the greater resistance—the one originally there or the unknown resistance. The galvanometer will indicate this by the deflection.

In this case the greater resistance is the unknown

resistance, because it has only moved the needle through 25°; it has, therefore, allowed less current to pass and possesses a higher resistance.

In the proportion

$$100 \text{ ohms} : \text{unknown ohms} = 25^\circ : 50^\circ$$

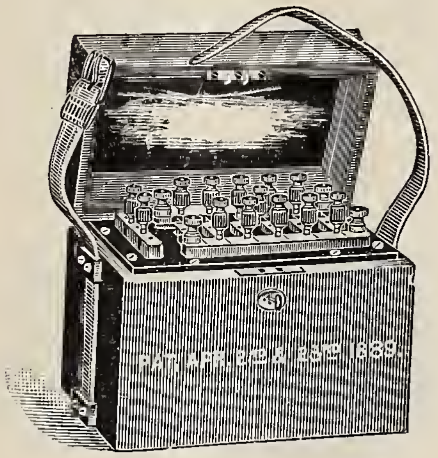
$$\text{Unknown ohms} = \frac{50^\circ}{25^\circ} \times 100 \text{ ohms.}$$

$$= 200 \text{ ohms.}$$

Resistance Boxes.—In order that standards may be conveniently handled, resistance boxes have been constructed composed of reels of German silver wire.

Standard Ohm.—The standard of resistance is the ohm; it has been made in two separate forms as a unit. One, the primitive form, is simply a mercury column of 106, 3 centimeters in length and a given weight of mercury, the diameter being about 1 millimeter; and the other, called the B. A. unit, is composed of wire, either German silver or platinum-silver alloy.

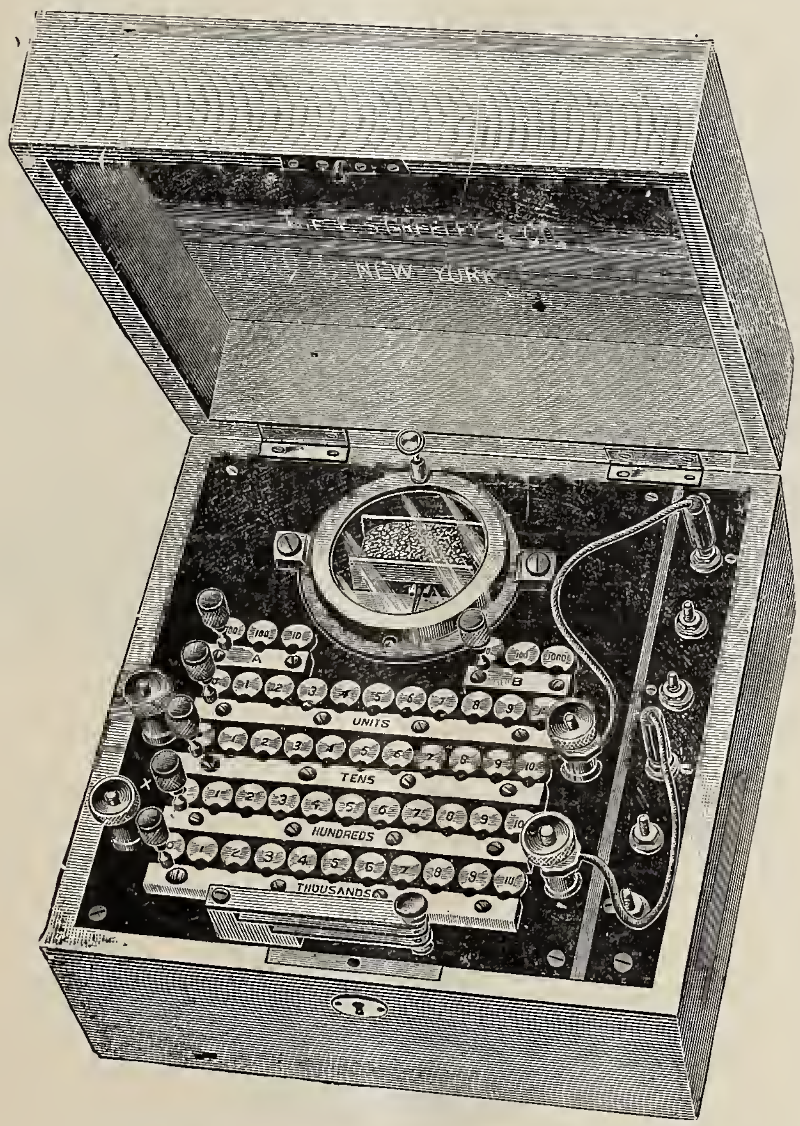
The general construction of resistance boxes is as follows: A series of reels of German silver wire are placed within a box, and their individual extremities connected to metal pieces on the outside. The extremities of each coil end in two brass blocks separated from each other, yet allowing a plug to be inserted between them when necessary.



Box of Standard Resistances.

By means of this plug the coil can be left in or cut out. When the plug is inserted the ends of the coil are in metallic communication, and the only resistance is that experienced by the current when passing between the metal blocks. The extremities of each coil are individually marked with their corresponding resistances.

The boxes are made of a resistance either great or small as desired. One box may read in tenths and units, another in units and tenths, or hundreds and thousands, etc.



Portable Wheatstone Bridge Testing Set.

The resistance to be measured greatly determines the box to be used. With a 100,000-ohm coil very high resistances may be measured with the aid of a good galvanometer.

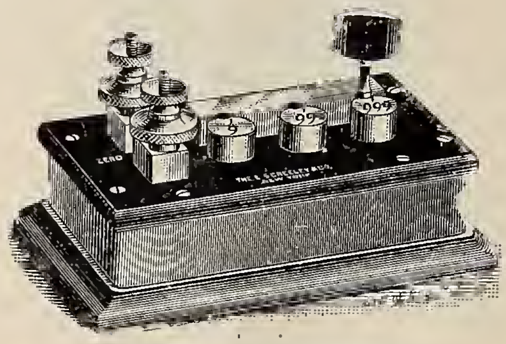
The Wheatstone bridge is used as in the above for either high or low resistances. The slide bridge, as seen in sketch, is utilized whenever it is desirable to measure very low resistances, the connections being the usual ones for a bridge test. When very low resistances are being

tested, the differently heated currents of air passing at the time affect the bridge, giving rise in it at all its joints to thermo-electric currents. Protection against these is obtained by covering such parts with cotton-wool and keeping doors and windows closed.

The metallic piece on the bridge slides along a wire of alloyed metals and by its movement forth or back creates the proportional arms required for a balance of the bridge.

with the same galvanometer than that hitherto employed. Thus testing cells of chloride of silver are very convenient when from 50 to 100 volts is necessary in such work.

The insulation resistance of a wire is the number of ohms' resistance of its outer covering. This, as a rule, is so high that it is not measured in single units but in groups of 1,000,000 ohms apiece. These larger units are called megohms.



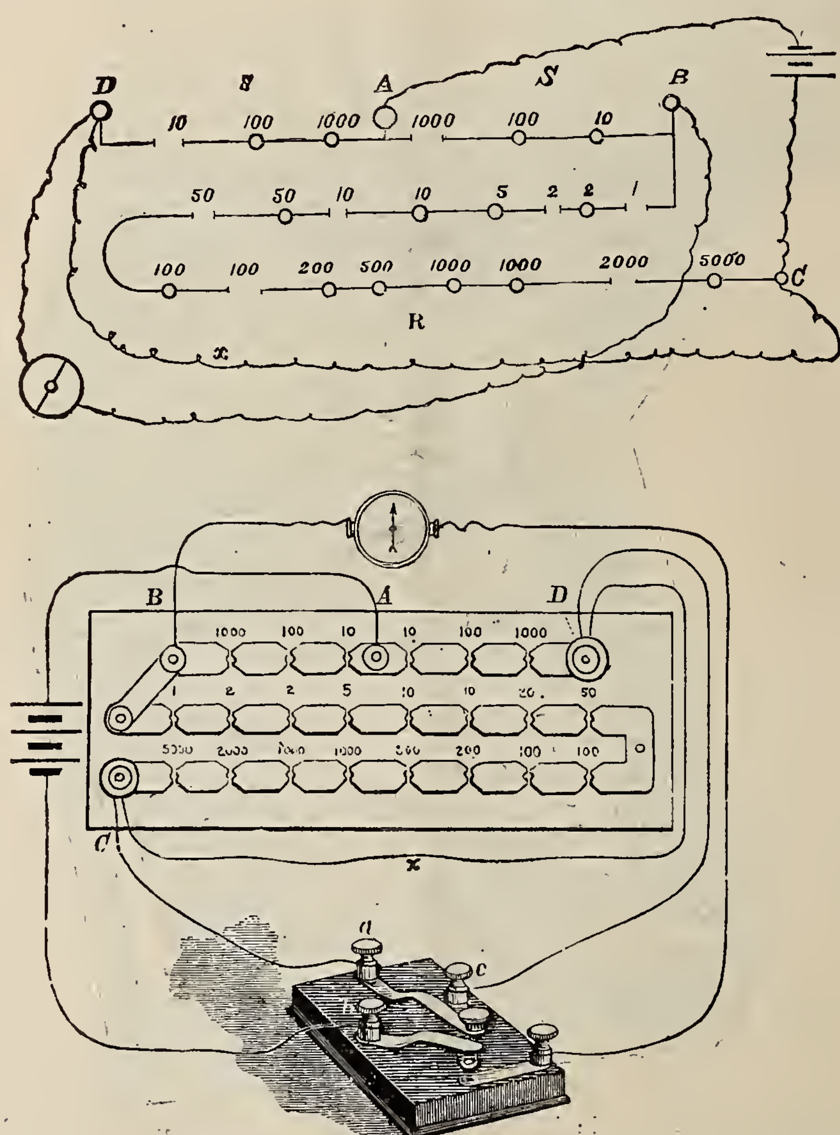
Galvanometer Shunt.

The two arms thus obtained by a division of the wire are not known in ohms, but are considered merely as proportional parts of each other.

If the wire is fifty inches long, the point at which the slide rests gives the arms either 15 and 35, 20 or 30, or any other arrangement. The other two known resistances are inserted in the shape of resistance boxes and unplugged to the required extent. A galvanometer is connected across to the proper terminals and the absence of deflection denotes a balance.

The process of substitution for the measurement of insulation resistance is very convenient if, instead of a galvanometer, a Weston voltmeter be utilized.

The volts are noted and the resistance of the voltmeter as given on the cover. If the volts read off are 110 and the voltmeter have a resistance of 15,000 ohms, the test is continued by connecting the voltmeter and insulation of the wire in series with each other. This is done by immersing the coil of wire in a tub of water, its two ends protruding.



Post Office Bridge Set with Diagram of Connections.

The larger bridge of higher resistance sometimes comes in the form of a box called a post-office set, but its use does not vary in the least from that just described. The divided wire or meter bridges are excellent for low resistances. When greater resistances are to be measured, although the principle employed does not alter in the least, the means for effecting the same does considerably. A very great resistance usually requires a greater pressure

One end is connected to the voltmeter, the other pole of the voltmeter to the source of current, and the remaining extremity from the current supply to the water. When a current tries to pass it must pass from the source of current through the voltmeter, through the covering of the wire back to the point of starting. If the voltmeter reads half a volt, the resistance of the covering is as follows:

(1) voltmeter = 15,000 ohms,
reading = 110 volts.
(2) voltmeter = 15,000 + unknown ohms,
reading = $\frac{1}{2}$ volt.

Therefore

$$15{,}000 + \text{unknown R} : 15{,}000 = 110 : \tfrac{1}{2};$$
$$15{,}000 \times 110 = \tfrac{1}{2} \times (15{,}000 + \text{unknown R})$$
$$= 7{,}500 + \tfrac{1}{2}\text{ unknown R};$$
$$\text{or } \tfrac{1}{2}\text{ unknown R} = 15{,}000 \times 110 - 7{,}500;$$
$$\text{or } \tfrac{1}{2}\text{ unknown R} = 3{,}285{,}000.$$

This answer would be given as 3.28 megohms. The same practice is carried on with a testing set and a galvanometer.

Shunts.—When using galvanometers for such work, a set of shunts are used called

$\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ shunts.

These are employed for the purpose of obtaining a readable deflection where a great pressure is applied to any high resistance. Were it not for these shunts a delicate galvanometer would be ruined by the heavy work thus put upon it and the experiment lack success. The above fractions denote the current passing through the galvanometers when they are used, the galvanometer taking $\frac{1}{9}$, $\frac{1}{99}$ or $\frac{1}{999}$ of the current from the circuit as the case may require.

BOOK REVIEWS.

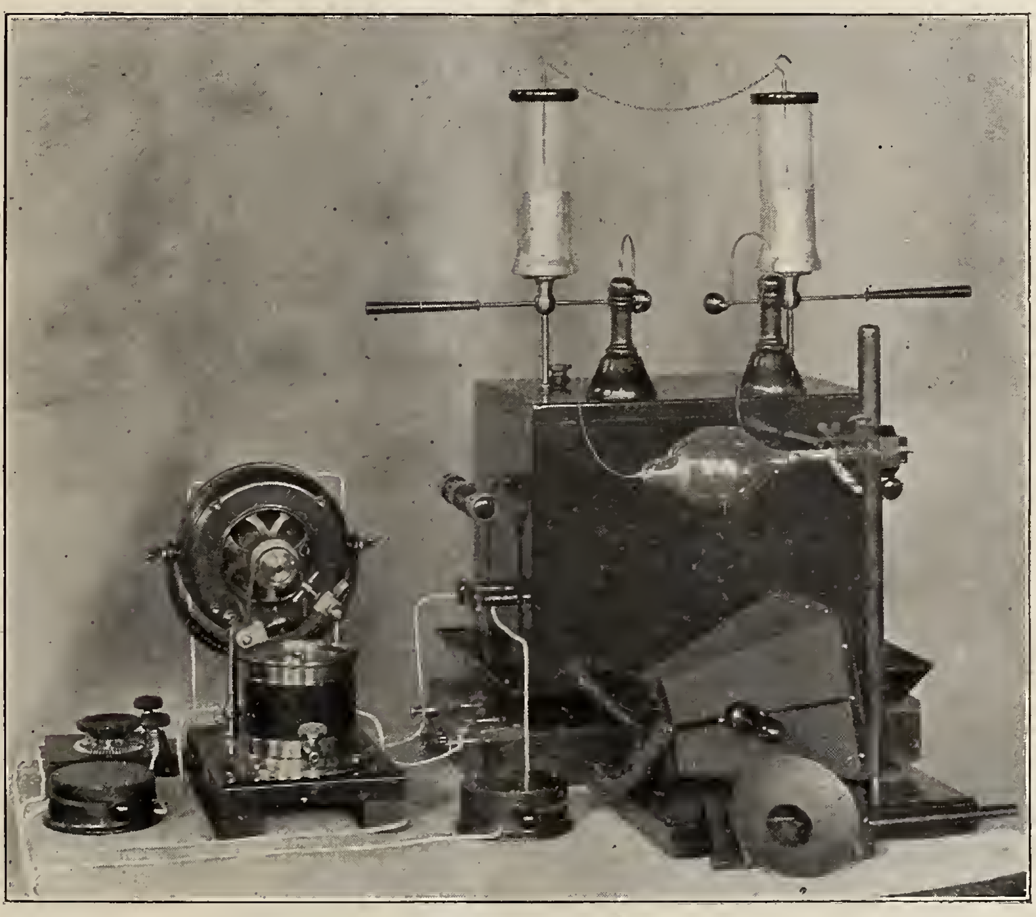
The A B C of the X-rays by William H. Meadowcroft. The sanctity of criticism is never less violated than when it calls for an opinion in a case where that opinion can only be of the best.

The furor of excitement produced by a new discovery, especially when its influence is visible in the leading sciences, naturally leads to a raft of literature being set afloat on the subject. For the untechnical mind, the man of every-day affairs, or the layman, a work of science generally raises an insurmountable barrier to true information and progress. A lucid description, untouched by depressing phrases, and written with a flow of diction that swings each new idea imperceptibly into place is the most valuable source of knowledge he can seek. Mr. Meadowcroft's book possesses these features; it enters into the explanation of the nature of X-rays as far as is known. His volume dissects in a simple and enjoyable manner the principles, indispensable to a thorough comprehension of the subject and leads the reader by gentle stages to the final and most interesting conclusions of the day.

The apparatns essential to a complete X-ray outfit, and the *reasons* for the use of each respective part are clearly set forth.

Many useful facts that throw light upon the subject are dilated upon with the assistance of appropriate diagrams.

Mr. Meadowcroft's desire to let each word have weight is evident throughout the volume. His method of explanation has smoothed away the difficulties of science, and let the reader into those mysteries concerning coils, batteries, Crookes tubes, condensers, etc., which comfort the ardent amateur investigator. We heartily recommend this choice little volume to our friends and readers. Sold by The American Technical Book Co., 45 Vesey street, N. Y.



Complete Set of X-Ray Apparatus—Frontispiece of A, B, C of Electricity.

X Rays by Edward Thompson, M. E. E. E. Price $1.50. The value of this book to students can bear no worthier recommennation than that received by the author from Lord Kelvin of England.

Lord Kelvin's (Sir Wm. Thomson, F. R. S.) Discussion of Thompson and Anthony's X-Ray Book.—I received it (the book) only a few days ago, but I have already looked nearly all through it, with great interest. I have seen enough to know that I shall find much most useful information in it, which will be always readily available because of the very excellent method and care with which you have given reference to authors, dates and publications, and I am sure all who are interested in the subject will find your book exceedingly valuable.

All your statements with reference to anything I have done on the subject are perfectly correct.

I believe that hitherto nothing in the way of diffraction has been discovered for the Roentgen rays.

I doubt very much the genuineness of Mackay's magnetographs (p. 25 of your book). No other experimenter,

so far as I know, has given any confirmation of his experiments. Believe me,

Yours truly,

Kelvin.

It seems as though the most strenuous efforts had been made to collect all matter relative to the subject of Roentgen Rays and there is little of the slightest consequence that has escaped notice. For data concerning X rays we can recommend no book as well, and for the latest facts whose bearing upon the ultimate meaning of the entire phenomenon, no one can doubt, are strikingly set forth.

Authorities exist within its covers whose name and work have made them famous.

Tesla, Edison, Pupin and others likewise add their quota of information. The book is excellent and even indispensable to the up-to-date reader. Its concluding chapter by Prof. Wm. A. Anthony is a lucid presentation of the facts—a refreshing dessert to a well-selected and artistic menu. Sold by the publishers D. Van Nostrand & Co., 23 Murray and 27 Warren streets, N. Y.

OBITUARY.

HARVEY L. LUFKIN.

Harvey Lamb Lufkin, general manager of the Crocker-Wheeler Electric Co., died Monday, December 21, at the Mount Sinai Hospital, of appendicitis. He had just returned from a long trip through the West and the South, and while on Saturday hopes for his recovery were entertained he began to fail Sunday morning and finally succumbed to the disease at nine o'clock Monday morning.

Mr. Lufkin was born in Cleveland, O., in 1857, was early interested in electricity, and as far back as 1886 became an associate of Messrs. Crocker and Wheeler in the C. & C. Company. The development of electric power as applied in mills and factories is due in a large degree to Mr. Lufkin's early conceptions of its possibilities and his persistent industry in enforcing his beliefs. The strongest evidence of the remarkable growth of the business during the period of his connection with the company is shown in a recent contract for a power plant, involving 1,000-horse power, of apparatus in which a 100-horse power motor was the smallest machine, and also in some of the largest industrial power plants in the country which have been furnished by the company; as the product at the time of his association with the company, in 1892, was confined to motors and dynamos of five-horse power and under. Some of the original work done by Mr. Lufkin in the field of applied electric power embraces almost all the leading events which have their place in history fully as much as the landmarks of lighting and railway development. Mr. Lufkin was also one of the promoters of the Electrical Expositon held in the Grand Central Palace last May.

Jahl & Ellis is the name of the new partnership formed by the successors to Frederick Noll, manufacturers' agent. Mr. Albert C. Jahl alone conducted the business of Mr. Noll for about a year. Previously he carried on the supply business on his own account. Mr. Jahl has had an extended experience of eight years in the electric railway construction line, and Mr. Burtis A. Ellis has had ten years' experience with electric lights and equipments, having been with the New York Electrical Equipment Co. since its inception and previously with the Edison Co. Messrs. Jahl & Ellis are both young men full of vigor and activity and their affairs are already in a successful condition. They are agents for the Interior Conduit and Insulation Co.'s conduits, motors, dynamos, electric exhaust and fan motors, and carry a big stock of wire, sockets, cut-outs, and everything for electric light, railway and power stations.

Daniel H. Gildersleeve, the eastern representative of the Snow Steam Pump Co., of Buffalo, N. Y., with offices at 126 Liberty street, this city, has taken the management of the Philadelphia offices, 506 Drexel Building, and the Boston office, 35 Congress street. Mr. Gildersleeve took the management of the New York office one year ago, since which time the business grew to such large proportions that he added several more rooms to meet the requirements. His business continued to increase and spread beyond his New York territory, so that he found it necessary to absorb the Philadelphia and Boston offices. It is said that Mr. Gildersleeve is doing more business in steam pumps, condensers, etc., than any other pump manufacturer, or representative, in this section. There is little room for doubt that Snow pumps are superior to any other make. Mr. Gildersleeve has surrounded himself with a staff of practical and competent assistants, and gives them every encouragement to secure the orders; and they get them.

E. H. Johnson, president of the Interior Conduit and Insulation Co., 527 W. 34th street, N. Y., returned home this week with his family, after an extended tour of England and France. He arrived on the steamer Teutonic, looking hale and hearty, and judging from his jovial appearance, he must have been a winner in disposing of his English and French interests.

Baechtold & Parker Electric Co., No. 79 and 81 Washington street, Brooklyn, N. Y., have just bought out a complete 300-light arc plant of the American System. Ten big 30-light arc dynamos were seen by our representative.

INDEX TO ADVERTISERS.

American Engine Co....vi
Automatic Circuit Breaker Co....vii
Ball, H. P., Mfg. Co....xii
Bogue, C. J....i
Brixey, W. R....i
Bidstrup & Graham....iii
C & C Electric Co....i
Central Mfg. Co....ix
Central Electric and Foundry Co....i
Chesley Electric Co....iii
Columbia Phonograph Co....iv
Columbine, J....ii
Cleveland & Taylor....iii
Diehl Mfg. Co....vi
Edison Decorative & Miniature Lamp Dept....vii
Edwards & Co....v
Egbert, F. W....iii
Electricity Taught at Night....viii
Ettinger & Freed....vii
Farnsworth, A. J....i
Field and Flowers....x
Gleason Mfg. Co., E. P....ix
Greeley & Co., The E. S....xii
Hatzel & Buehler....iii
Hinds, C. H....vii
Hine & Robertson....iii
Hull, J. H....xi
Interior Conduit and Insulation Co....i, v
Lamarche's Sons, H....ii
Marshall, Wm....viii
McIntire Co., C....iii
McLeod, Ward & Co....xii
McCafferty, H. F....vii
Mianus Electric Co....viii
New York Telephone Co....i
Okonite Co., Limited....i
Partridge Carbon Co....i
Phillips Insulated Wire Co....i
Phœnix Glass Co....ii
Prentiss Tool and Supply Co....vii
Replogle Governor Works....iii
Rosenbaum, Wm. A....i
Henry Roessle....vii
Rossiter, MacGovern & Co....iii
Safety Insulated Wire & Cable Co....i
Schiff, Jordan & Co....xii
Scott Electric Lamp Co., The....ii
Standard Electric Lamp and Novelty Co....i
Standard Underground Cable Co....
Stucky & Heck....iii
Tables for Wiremen....viii
Tupper, W. W. & Co....vii
Vosburgh, Mfg. Co., Limited, W. C....vi
Vulcanized Fibre Co....772
Vulcan Company....ii
Wants....iii
Washington Patent Agency....i
Watson-Stillman Co....i
Wedderburn, John, & Co....viii, ii
Weston Electrical Instrument Co....772
White Co., O. C....ii
Zimdars & Hunt....ix
Fill out Subscription Blank....iv

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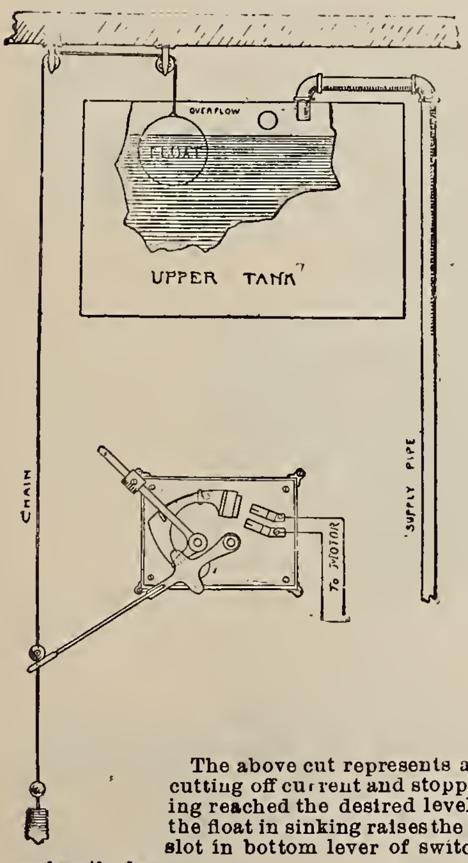

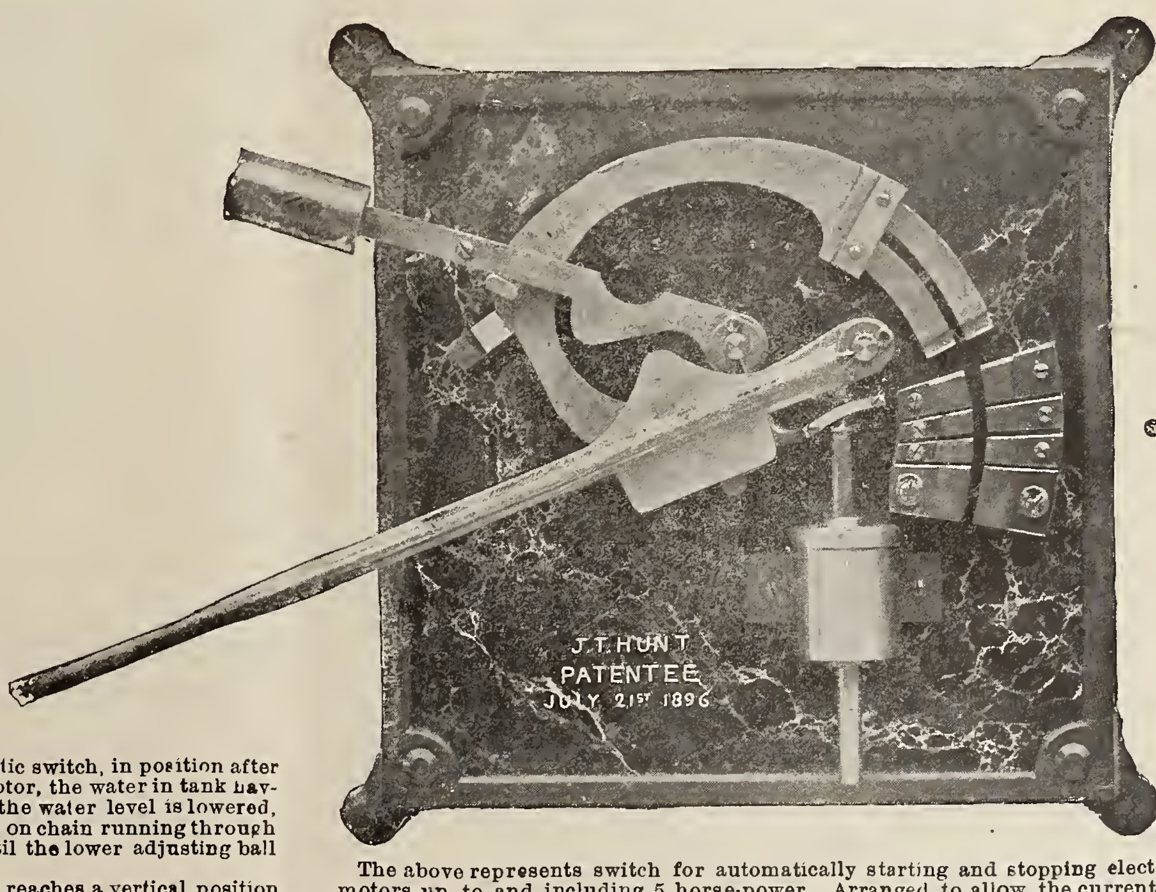

The above cut represents automatic switch, in position after cutting off current and stopping motor, the water in tank having reached the desired level. As the water level is lowered, the float in sinking raises the weight on chain running through slot in bottom lever of switch. until the lower adjusting ball reaches the lever.
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See descriptive article in this week's issue.

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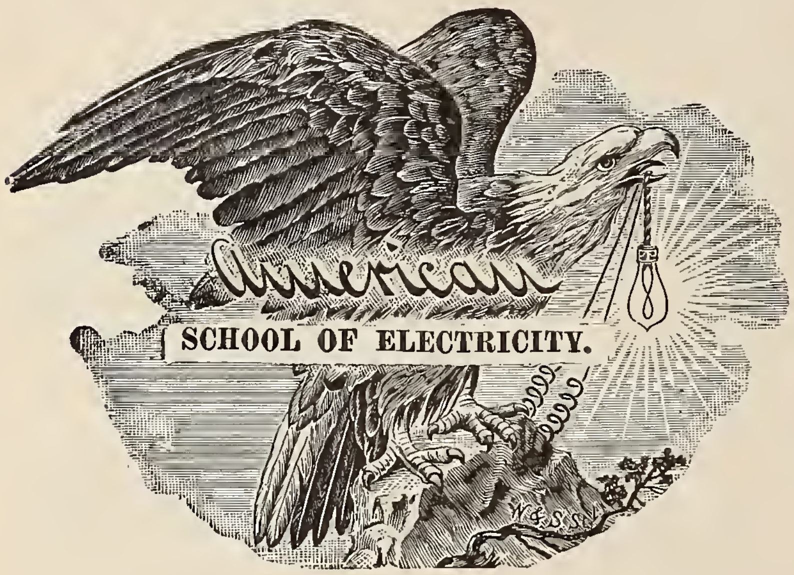

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